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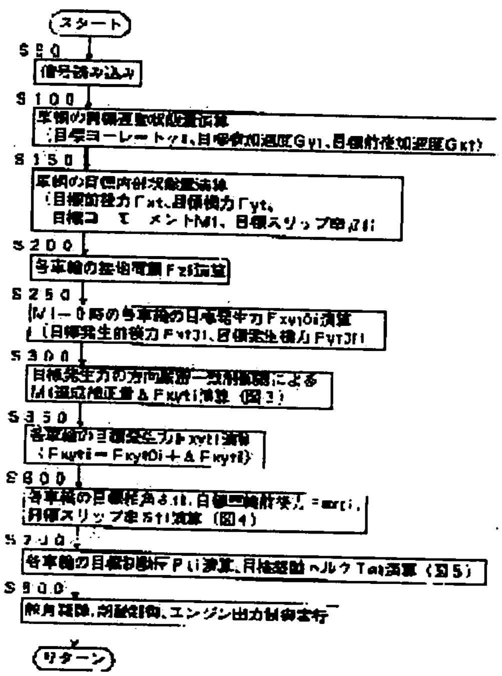
(54) RUNNING CONTROLLER FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve the running property of a vehicle more than the running property of a vehicle using a conventional running controller by controlling a steering angle of each wheel and controlling a generation force of each wheel.

SOLUTION: A target front and rear force Fxt, a target lateral force Fyt, and a target yaw moment Mt of the vehicle are computed (S100, 150), a first target generation force Fxyt0i of each wheel achieving the target front and rear force Fxt and the target lateral force Fyt is computed without giving yaw moment to the vehicle (S200, 250), a second target generation force ΔFxyti of each wheel for achieving the target yaw moment Mt only of the vehicle is computed (S300), and the target generation force Fxyti of each wheel as the sum of FxytOi and ΔFxyti is computed (S350). A target steering angle δti, a target wheel front and rear force Fwxti, and a target slip rate Sti of each wheel achieving the target generation force Fxyti are computed (S600), and a target braking pressure Pti of each wheel and a target drive torque Tet of an engine are computed (S700) to control so that a steering angle of each wheel becomes the target steering angle δti, an output torque of the engine 10 becomes the target drive torque Tet, and a braking pressure of each wheel becomes the target braking pressure Pti (S800).



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CLAIMS

[Claim(s)]
[Claim 1] The rudder angle and braking/driving force of each wheel are used as the transit control unit of the vehicle equipped with the controllable rudder angle control means and the braking/driving force control means according to the individual, respectively. A means to detect the amount of steering control operation by the operator, and a means to detect the amount of driving force control operation by the operator, A means to detect the amount of damping force control operation by the operator, and the amount of steering control operation by the operator, A vehicle target quantity of state operation means to calculate the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle based on the amount of driving force control operation, and the amount of damping force control operation, Said target order force, said target lateral force, and a wheel target generating force operation means to calculate the target generating force of each wheel based on said target yaw moment, A wheel target controlled-variable operation means to calculate the target rudder angle and target braking/driving torque of each wheel based on the target generating force of each of said wheel, The transit control unit of the vehicle characterized by having the control means which controls said rudder angle control means and said braking/driving force control means so that the rudder angle and braking/driving torque of each wheel turn into said target rudder angle and said target braking/driving torque, respectively.
[Claim 2] While the direction of resultant force of the target generating force of each of said wheel meets towards resultant force with the target order force of said vehicle, and the target lateral force of said vehicle, said wheel target generating force operation means The transit control unit of the vehicle according to claim 1 characterized by determining the magnitude and the direction of the target generating force of said each wheel that the target order force of said vehicle, the target lateral force of said vehicle, and the target yaw moment of said vehicle are attained by resultant force of the target generating force of each of said wheel.
[Claim 3] The first target generating force operation means which calculates the first target generating force of each wheel for attaining the target order force of said vehicle, and the target lateral force of said vehicle, without said wheel target generating force operation means giving said target yaw moment to a vehicle, It has the second target generating force operation means which calculates the second target generating force of each wheel for attaining only said target yaw moment. The transit control unit of the vehicle according to claim 2 characterized by calculating the target generating force of each of said wheel as the sum of said first target generating force and said second target generating force.
[Claim 4] Said vehicle has a right-and-left front wheel and a right-and-left rear wheel, and said wheel target generating force operation means has a means to search for the touch-down load of each wheel. Said first target generating force operation means calculates the first target generating force of each of said wheel by distributing resultant force with the target order force of said vehicle, and the target lateral force of said vehicle to each wheel in proportion to the touch-down load of each wheel. Said second target generating force operation means in order to attain only said target yaw moment based on the direction of resultant force with said target yaw moment and the target order force of said vehicle, and the target lateral force of said vehicle A means to calculate the yaw moment generating force of a rear wheel of making fixed relation to the yaw moment generating force of said front wheel as the sum total of the force which a right-and-left rear wheel should generate while calculating the yaw moment generating force of a front wheel as the sum total of the force which a right-and-left front wheel should generate, While distributing the yaw moment generating force of said front wheel to a right-and-left front wheel in proportion to the touch-down load of a right-and-left front wheel The transit control unit of the vehicle according to claim 3 characterized by having a means to calculate the second target generating force of each of said wheel by distributing the yaw moment generating force of said rear wheel to a right-and-left rear wheel in proportion to the touch-down load of a right-and-left rear wheel.
[Claim 5] Said wheel target generating force operation means has a means to search for the touch-down load of each wheel. Said first target generating force operation means calculates the first target generating force of each of said wheel by distributing resultant force with the target order force of said vehicle, and the target lateral force of said vehicle to each wheel in proportion to the touch-down load of each wheel. A wheel specification means to specify the wheel made suitable for generating [means / said / second / target generating force operation] said second target generating force efficiently based on the target order force of said vehicle, and the target lateral force of said vehicle, It has a means to calculate said second target generating force as force of a direction perpendicular to said first target generating force about said specified wheel. A means by which said wheel target generating force operation means sets the target generating force of said specified wheel as resultant force with said first target generating force and said second target generating force, A means to set the target generating force of wheels other than said specified wheel as said first target generating force of corresponding, So that resultant force with said target generating force of said specified wheel and said target generating force of wheels other than said specified wheel may attain the target order force of said vehicle, and the target lateral force of said vehicle The transit control unit of the vehicle according to claim 3 characterized by having a means to amend the magnitude of said target generating force of said specified wheel, and said target generating force of wheels other than said specified wheel.
[Claim 6] Said wheel specification means is the transit control unit of the vehicle according to claim 6 with which the arm length of the yaw moment of the circumference of the center of gravity of the vehicle by said second target generating force is characterized by specifying the wheel of the larger one among wheels on either side as a wheel made suitable for generating said second target generating force efficiently.
[Claim 7] A means to calculate the target travelling direction angle of the grounding point of each wheel [as opposed to the cross direction of a vehicle in said wheel target controlled-variable operation means], A means to calculate the target touch-down load of each wheel, and a means to calculate the target wheel order force and target wheel lateral force in the wheel coordinate of each wheel based on said target generating force and the last target rudder angle, A means to calculate the target slip angle of each wheel as the sum of the target travelling direction angle of the grounding point of each of said wheel, and the last target rudder angle, A means to calculate the lateral-force generating forecast and target slip ratio of each wheel based on the target wheel order force of each of said

wheel, the target slip angle of each of said wheel, and the target touch-down load of each of said wheel, The transit control unit of the vehicle according to claim 1 characterized by having a means to calculate the target rudder angle and target running torque of each wheel based on the target wheel order force of each of said wheel, the target wheel lateral force of each of said wheel, the lateral-force generating forecast of each of said wheel, and the target slip ratio of each of said wheel.
[Claim 8] A means to calculate the target rudder angle and target running torque of each of said wheel When the magnitude of the deflection of said target wheel lateral force and said lateral-force generating forecast is under a reference value Set the target rudder angle of each wheel as the last target rudder angle, and when the magnitude of the deflection of said target wheel lateral force and said lateral-force generating forecast is beyond a reference value The transit control unit of the vehicle according to claim 7 characterized by the last target rudder angle setting the value corrected in said amount of target rudder angle corrections as the target rudder angle of each wheel while calculating the amount of target rudder angle corrections based on the deflection of said target wheel lateral force and said lateral-force generating forecast.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the transit control unit of a vehicle, and relates the rudder angle and braking/driving force of each wheel to a detail according to an individual further at the transit control unit of a controllable vehicle.
[0002]
[Description of the Prior Art] As one of the transit control units of vehicles, such as an automobile, the transit control unit constituted so that the yaw moment of a vehicle might be controlled is conventionally known by controlling the damping force of each wheel according to an individual based on a vehicle model and a tire model as indicated by for example, the Patent Publication Heisei No. 500380 [11 to] official announcement official report. According to this kind of transit control unit, it can be made to run a vehicle stably as compared with the case where the yaw moment of a vehicle is not controlled.
[0003]
[Problem(s) to be Solved by the Invention] Generally, transit movement of a vehicle is prescribed by the vehicle order force, lateral force, and the yaw moment, and the vehicle order force, lateral force, and the yaw moment are determined by the magnitude and the direction of the force which each wheel generates to a road surface. Moreover, in order to make it run a vehicle that it is proper and stably according to an operator's operation, the magnitude and the direction of the force which each wheel generates to a road surface must be controlled so that the vehicle order force, lateral force, and the yaw moment must be controlled by the desired value corresponding to an operator's steering control operation, driving force control operation, and damping force control operation, therefore the vehicle order force, lateral force, and the yaw moment become desired value.
[0004] However, it sets to the conventional transit control unit like ****. Since only the braking/driving force of a wheel is controlled on the assumption that the rudder angle of a steering wheel is a rudder angle corresponding to an operator's steering control operation and the rudder angle of a non-steering wheel is constancy, A limitation is in the magnitude of the force which each wheel generates, and the control range of a direction, and the engine performance of a wheel (tire) cannot be demonstrated to the maximum extent, therefore there is room of an improvement in the conventional transit control unit at the point which raises the performance traverse of a vehicle.
[0005] Moreover, it sets to the conventional common transit control unit. The braking/driving force of each wheel is controlled by feedback control according to an individual so that this deflection becomes small based on the deflection of the target behavior index value of a vehicle, and the actual behavior index value of a vehicle. Since transit control is performed that it should cope with that the actual behavior of a vehicle shifted from target behavior and feedback gain cannot be made high from the need for stability reservation of control, such as antihunting, There is room of an improvement at the point which cannot control transit movement of a vehicle certainly and effectively, therefore raises the performance traverse of a vehicle also to the conventional common transit control unit.
[0006] This invention is made in view of the problem like **** in the conventional transit control unit constituted so that transit movement of a vehicle might be controlled by controlling the braking/driving force of each wheel. While the main technical problems of this invention expand the magnitude of the force which also makes the rudder angle of each wheel a controlled system, and each wheel generates, and the control range of a direction By controlling the magnitude and the direction of the force which each wheel generates so that it may become in the magnitude and the direction required to attain transit movement of the proper vehicle corresponding to an operator's operation, it is raising the performance traverse of a vehicle as compared with the case of the conventional transit control unit.
[0007]
[Means for Solving the Problem] According to this invention, main above-mentioned technical problems are made into the configuration of claim 1, i.e., the transit control unit of a vehicle equipped with the controllable rudder angle control means and the braking/driving force control means for the rudder angle and braking/driving force of each wheel according to the individual, respectively. A means to detect the amount of steering control operation by the operator, and a means to detect the amount of driving force control operation by the operator, A means to detect the amount of damping force control operation by the operator, and the amount of steering control operation by the operator, A vehicle target quantity of state operation means to calculate the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle based on the amount of driving force control operation, and the amount of damping force control operation, Said target order force, said target lateral force, and a wheel target generating force operation means to calculate the target generating force of each wheel based on said target yaw moment, A wheel target controlled-variable operation means to calculate the target rudder angle and target braking/driving force of each wheel based on the target generating force of each of said wheel, It is attained by the transit control unit of the vehicle characterized by having the control means which controls said rudder angle control means and said braking/driving force control means so that the rudder angle and braking/driving force of each wheel turn into said target rudder angle and said target braking/driving force, respectively.
[0008] According to the configuration of above-mentioned claim 1, a vehicle is equipped with a controllable rudder angle control means according to an individual for the rudder angle of each wheel. It is based on the amount of steering control operation by the operator, the amount of driving force control operation, and the amount of damping force control operation. The target order force of a vehicle, The target lateral force of a vehicle and the target yaw moment of a vehicle calculate. The target order force of a vehicle, The target generating force of each wheel calculates based on the target lateral force of a vehicle, and the target yaw moment of a vehicle. Since it is controlled so that the target rudder angle and target braking/driving torque of each wheel calculate based on the target generating force of each wheel and the rudder angle and braking/driving torque of each wheel turn into a target rudder angle and target braking/driving torque, respectively As compared with the case where the rudder angle and braking/driving torque of each wheel are

controlled so that the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle are attained by the generating force of each wheel, and only the braking/driving force of each wheel is controlled by this, the performance traverse of a vehicle improves certainly.
[0009] Moreover, according to this invention, it sets in the configuration of above-mentioned claim 1 that main above-mentioned technical problems should be attained effectively. While the direction of resultant force of the target generating force of each of said wheel meets towards resultant force with the target order force of said vehicle, and the target lateral force of said vehicle, said wheel target generating force operation means It is constituted so that the magnitude and the direction of the target generating force of said each wheel may be determined that the target order force of said vehicle, the target lateral force of said vehicle, and the target yaw moment of said vehicle are attained by resultant force of the target generating force of each of said wheel (configuration of claim 2).
[0010] While the direction of resultant force of the target generating force of each wheel meets towards resultant force of the target order force of a vehicle, and the target lateral force of a vehicle according to the configuration of claim 2 Since the magnitude and the direction of the target generating force of each wheel are determined that the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle are attained by resultant force of the target generating force of each wheel The magnitude and the direction of the target generating force of each wheel are determined that the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle are efficiently attained by the generating force of each wheel.
[0011] Moreover, according to this invention, it sets in the configuration of above-mentioned claim 2 that main above-mentioned technical problems should be attained effectively. The first target generating force operation means which calculates the first target generating force of each wheel for attaining the target order force of said vehicle, and the target lateral force of said vehicle, without said wheel target generating force operation means giving said target yaw moment to a vehicle, It has the second target generating force operation means which calculates the second target generating force of each wheel for attaining only said target yaw moment, and it is constituted so that the target generating force of each of said wheel may be calculated as the sum of said first target generating force and said second target generating force (configuration of claim 3).
[0012] The first target generating force of each wheel for attaining the target order force of a vehicle and the target lateral force of a vehicle according to the configuration of claim 3, without giving the target yaw moment to a vehicle calculates. Since the second target generating force of each wheel for attaining only the target yaw moment calculates and the target generating force of each wheel calculates as the sum of the first target generating force and the second target generating force The target generating force of each wheel calculates so that the target order force of a vehicle, target lateral force, and the target yaw moment may be attained certainly.
[0013] Moreover, according to this invention, it sets in the configuration of above-mentioned claim 3 that main above-mentioned technical problems should be attained effectively. Said vehicle has a right-and-left front wheel and a right-and-left rear wheel, and said wheel target generating force operation means has a means to search for the touch-down load of each wheel. Said first target generating force operation means calculates the first target generating force of each of said wheel by distributing resultant force with the target order force of said vehicle, and the target lateral force of said vehicle to each wheel in proportion to the touch-down load of each wheel. Said second target generating force operation means in order to attain only said target yaw moment based on the direction of resultant force with said target yaw moment and the target order force of said vehicle, and the target lateral force of said vehicle A means to calculate the yaw moment generating force of a rear wheel of making fixed relation to the yaw moment generating force of said front wheel as the sum total of the force which a right-and-left rear wheel should generate while calculating the yaw moment generating force of a front wheel as the sum total of the force which a right-and-left front wheel should generate, While distributing the yaw moment generating force of said front wheel to a right-and-left front wheel in proportion to the touch-down load of a right-and-left front wheel By distributing the yaw moment generating force of said rear wheel to a right-and-left rear wheel in proportion to the touch-down load of a right-and-left rear wheel, it is constituted so that it may have a means to calculate the second target generating force of each of said wheel (configuration of claim 4).
[0014] According to the configuration of claim 4, the touch-down load of each wheel is searched for, and the first target generating force of each wheel calculates by distributing resultant force with the target order force of a vehicle, and the target lateral force of a vehicle to each wheel in proportion to the touch-down load of each wheel. In order to attain only the target yaw moment based on the direction of resultant force with the target yaw moment and the target order force of a vehicle, and the target lateral force of a vehicle The yaw moment generating force of a rear wheel of making fixed relation to the yaw moment generating force of a front wheel as the sum total of the force which a right-and-left rear wheel should generate while the yaw moment generating force of a front wheel calculates as the sum total of the force which a right-and-left front wheel should generate calculates. Since the second target generating force of each wheel calculates by distributing the yaw moment generating force of a rear wheel to a right-and-left rear wheel in proportion to the touch-down load of a right-and-left rear wheel while the yaw moment generating force of a front wheel is distributed to a right-and-left front wheel in proportion to the touch-down load of a right-and-left front wheel Without the direction of resultant force of the target generating force of each wheel breaking down the relation which meets towards resultant force of the target order force of a vehicle, and the target lateral force of a vehicle Moreover, the second target generating force of each wheel of attaining the target yaw moment calculates certainly, without breaking down greatly the relation in which the target generating force of each wheel is proportional to the touch-down load of each wheel.
[0015] Moreover, according to this invention, it sets in the configuration of above-mentioned claim 3 that main above-mentioned technical problems should be attained effectively. Said wheel target generating force operation means has a means to search for the touch-down load of each wheel. Said first target generating force operation means calculates the first target generating force of each of said wheel by distributing resultant force with the target order force of said vehicle, and the target lateral force of said vehicle to each wheel in proportion to the touch-down load of each wheel. A wheel specification means to specify the wheel made suitable for generating [means / said / second / target generating force operation] said second target generating force efficiently based on the target order force of said vehicle, and the target lateral force of said vehicle, It has a means to calculate said second target generating force as force of a direction perpendicular to said first target generating force about said specified wheel. A means by which said wheel target generating force operation means sets the target generating force of said specified wheel as resultant force with said first target generating force and said second target generating force, A means to set the target generating force of wheels other than said specified wheel as said first target generating force of corresponding, So that resultant force with said target generating force of said specified wheel and said target generating force of wheels other than said specified wheel may attain the target order force of said vehicle, and the target lateral force of said vehicle It is constituted so that it may have a means to amend the magnitude of said target generating force of said specified wheel, and said target generating force of wheels other than said specified wheel (configuration of claim 5).
[0016] According to the configuration of claim 5, the touch-down load of each wheel is searched for, and the first target generating force of each wheel calculates by distributing resultant force with the target order force of a vehicle, and the target lateral force of a vehicle to each wheel in proportion to the touch-down load of each wheel. The wheel made suitable for generating the second target

generating force efficiently based on the target order force of a vehicle and the target lateral force of a vehicle is specified. The second target generating force calculates as force of a direction perpendicular to the first target generating force about the specified this wheel. The target generating force of the specified wheel is set as resultant force with the first target generating force and the second target generating force. It is set as the first target generating force in which the target generating force of wheels other than the specified wheel corresponds. Since the magnitude of the target generating force of each wheel is amended so that resultant force with the target generating force of the specified wheel and the target generating force of wheels other than the specified wheel may attain the target order force of a vehicle, and the target lateral force of a vehicle Without the direction of resultant force of the target generating force of each wheel breaking down the relation which meets towards resultant force of the target order force of a vehicle, and the target lateral force of a vehicle, while the target generating force of each wheel is proportional to the touch-down load of each wheel completely The target generating force of each wheel for attaining the target order force of a vehicle, target lateral force, and the target yaw moment calculates certainly.

[0017] Moreover, that main above-mentioned technical problems should be attained effectively, as a wheel made suitable for generating said second target generating force efficiently, among wheels on either side, according to this invention, in the configuration of above-mentioned claim 5, said wheel specification means is constituted so that the arm length of the yaw moment of the circumference of the center of gravity of the vehicle by said second target generating force may specify the wheel of the larger one (configuration of claim 6).

[0018] According to the configuration of claim 6, as a wheel made suitable for generating the second target generating force efficiently, since a wheel with the larger arm length of the yaw moment of the circumference of the center of gravity of the vehicle by the target generating force of [second] the wheels on either side is specified As compared with the case where other wheels are specified, the magnitude of the second target generating force may be small, and the amount of amendments to the magnitude of the target generating force of the wheel specified by this and the target generating force of wheels other than the specified wheel also becomes small.

[0019] Moreover, a means to calculate the target travelling direction angle of the grounding point of each wheel [as opposed to the cross direction of a vehicle in said wheel target controlled-variable operation means] in the configuration of above-mentioned claim 1 that main above-mentioned technical problems should be attained effectively according to this invention, A means to calculate the target touch-down load of each wheel, and a means to calculate the target wheel order force and target wheel lateral force in the wheel coordinate of each wheel based on said target generating force and the last target rudder angle, A means to calculate the target slip angle of each wheel as the sum of the target travelling direction angle of the grounding point of each of said wheel, and the last target rudder angle, A means to calculate the lateral-force generating forecast and target slip ratio of each wheel based on the target wheel order force of each of said wheel, the target slip angle of each of said wheel, and the target touch-down load of each of said wheel, It is constituted so that it may have a means to calculate the target rudder angle and target running torque of each wheel based on the target wheel order force of each of said wheel, the target wheel lateral force of each of said wheel, the lateral-force generating forecast of each of said wheel, and the target slip ratio of each of said wheel (configuration of claim 7).

[0020] According to the configuration of claim 7, the target travelling direction angle of the grounding point of each wheel to the cross direction of a vehicle calculates. The target touch-down load of each wheel calculates, and the target wheel order force and target wheel lateral force in the wheel coordinate of each wheel calculate based on the target generating force and the last target rudder angle. The target slip angle of each wheel calculates as the sum of the target travelling direction angle of the grounding point of each wheel, and the last target rudder angle. Based on the target wheel order force of each wheel, the target slip angle of each wheel, and the target touch-down load of each wheel, the lateral-force generating forecast and target slip ratio of each wheel calculate. Since the target rudder angle and target running torque of each wheel calculate based on the target wheel order force of each wheel, the target wheel lateral force of each wheel, the lateral-force generating forecast of each wheel, and the target slip ratio of each wheel The target rudder angle of each wheel for attaining the target generating force of each wheel and the target braking/driving torque of each wheel calculate certainly.

[0021] According to this invention, in the configuration of above-mentioned claim 7, moreover, a means to calculate the target rudder angle and target running torque of each of said wheel that main above-mentioned technical problems should be attained effectively When the magnitude of the deflection of said target wheel lateral force and said lateral-force generating forecast is under a reference value Set the target rudder angle of each wheel as the last target rudder angle, and when the magnitude of the deflection of said target wheel lateral force and said lateral-force generating forecast is beyond a reference value While calculating the amount of target rudder angle corrections based on the deflection of said target wheel lateral force and said lateral-force generating forecast, it is constituted so that the last target rudder angle may set the value corrected in said amount of target rudder angle corrections as the target rudder angle of each wheel (configuration of claim 8).

[0022] When the magnitude of the deflection of target wheel lateral force and a lateral-force generating forecast is under a reference value according to the configuration of claim 8 The target rudder angle of the wheel concerned is set as the last target rudder angle, and when the magnitude of the deflection of target wheel lateral force and a lateral-force generating forecast is beyond a reference value Since the value from which the last target rudder angle was corrected in the amount of target rudder angle corrections is set as the target rudder angle of the wheel concerned while the amount of target rudder angle corrections calculates based on the deflection of target wheel lateral force and a lateral-force generating forecast, it calculates certainly, without the target rudder angle of each wheel emitting.

[0023]

[The desirable mode of a technical-problem solution means] According to one desirable mode of this invention, it sets in the configuration of above-mentioned claim 1. The amount of steering control operation according [a vehicle target quantity of state operation means] to an operator, the amount of driving force control operation, It is based on the amount of damping force control operation. The target order acceleration of a vehicle, the target lateral acceleration of a vehicle, It is constituted so that the target yaw rate of a vehicle may be calculated and the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle may be calculated based on the target order acceleration of a vehicle, the target lateral acceleration of a vehicle, and the target yaw rate of a vehicle, respectively (desirable mode 1).

[0024] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 1, a braking/driving force control means is constituted so that it may consist of a driving force control means and a damping force control means (desirable mode 2).

[0025] other one desirable voice of this invention -- if it depends like -- the above -- in the configuration of the desirable mode 2, a driving force control means controls the driving force of all wheels in the gross, and in the damping force of each wheel, a damping force control means is constituted so that it may be controllable according to an individual (desirable mode 3).

[0026] other one desirable voice of this invention -- if it depends like -- the above -- in the configuration of the desirable mode 2, it is

constituted so that the driving force control means may be controllable according to an individual in the driving force of each wheel and the damping force control means may be controllable according to an individual in the damping force of each wheel (desirable mode 4).
[0027] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 1, a vehicle is constituted so that it may be the four-flower vehicle which has a right-and-left front wheel and a right-and-left rear wheel (desirable mode 5).
[0028] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 4, the yaw moment generating force of a front wheel and the yaw moment generating force of a rear wheel are constituted so that it may be the same value (desirable mode 6).
[0029] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 4, distance of the vehicle cross direction between the center of gravity of a vehicle and a front-wheel axle is set to Lf, and by setting distance of the vehicle cross direction between the center of gravity of a vehicle, and a rear wheel axle to Lr, the ratio of the magnitude of the yaw moment generating force of a front wheel to the magnitude of the yaw moment generating force of a rear wheel is constituted so that it may be Lr/Lf (desirable mode 7).
[0030] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 4, a means to search for the touch-down load of each wheel is constituted so that the touch-down load of each wheel may be calculated by presumption based on the mass of a vehicle, vehicle order acceleration, and the lateral acceleration of a vehicle (desirable mode 8).
[0031] According to other one desirable mode of this invention, it sets in the configuration of above-mentioned claim 5. A vehicle is a four-flower vehicle which has a right-and-left front wheel and a right-and-left rear wheel, and when the target order force of a vehicle and the target lateral force of a vehicle are not 0, a wheel specification means It is constituted so that two wheels of a forward left ring and a right rear ring or a forward right ring, and a left rear ring may be specified based on the direction of the target order force of a vehicle, and the direction of the target lateral force of a vehicle (desirable mode 9).
[0032] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 5, a vehicle is a four-flower vehicle which has a right-and-left front wheel and a right-and-left rear wheel, and when the target order force of a vehicle or the target lateral force of a vehicle is 0, a wheel specification means is constituted so that all wheels may be specified (desirable mode 10).

[0033] In the desirable mode 9 or the configuration of 10 other one desirable voice of this invention -- if it depends like -- the above -- When larger than the magnitude of the first target generating force of a wheel in which the magnitude of the second calculated target generating force was specified, a means to calculate the second target generating force is constituted so that the magnitude of the second target generating force may be amended in the magnitude of the first target generating force of the wheel concerned (desirable mode 11).
[0034] According to other one desirable mode of this invention, it sets in the configuration of above-mentioned claim 7. The driving force control means which controls the driving force of all wheels in the gross when a vehicle has the drive system which transmits the driving torque of a driving source and a driving source to each wheel by the fixed allocation ratio and a braking/driving force control means controls the driving torque of a driving source, The damping force of each wheel is consisted of a controllable damping force control means according to an individual. Said control means calculates the target driving torque of a driving source based on the maximum of a driving side among the target running torques of each wheel. It is constituted so that a target damping force controlled variable may be calculated based on said maximum and the target running torque of other wheels about other wheels other than the wheel whose target running torque is max (desirable mode 12).
[0035] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 7, a means to calculate the target rudder angle and target running torque of each wheel is constituted so that the amount of corrections of the target rudder angle of each wheel may be calculated based on the target wheel lateral force and the lateral-force generating forecast of each wheel and the target rudder angle of each wheel may be calculated as the sum with the amount of corrections of the last target rudder angle and a target rudder angle (desirable mode 13).
[0036] According to other one desirable mode of this invention, it sets in the configuration of above-mentioned claim 7. A means to calculate the target rudder angle and target running torque of each wheel calculates the target wheel acceleration of each wheel based on the target slip ratio of each wheel. It is constituted so that the target running torque of each wheel may be calculated as the sum of the first [based on the target wheel order force of each wheel] target running torque, and the second [based on the target wheel acceleration of each wheel] target running torque (desirable mode 14).
[0037] According to other one desirable mode of this invention, in the configuration of above-mentioned claim 8, a means to calculate the target rudder angle and target running torque of each wheel is constituted so that the amount of target rudder angle corrections may be calculated as a value proportional to the deflection of target wheel lateral force and a lateral-force generating forecast (desirable mode 15).
[0038]
[Embodiment of the Invention] This invention is explained to a detail about some desirable operation gestalten, referring to drawing of attachment in the following.
[0039] The first operation gestalt drawing 1 is the outline block diagram showing the first operation gestalt of the transit control unit of the vehicle by this invention.
[0040] In drawing 1, 10 shows the engine as a driving source carried in the vehicle 12, the driving force of an engine 10 is transmitted to an output shaft 18 through a torque converter 14 and transmission 16, and the driving force of an output shaft 18 is transmitted to the driveshaft 22 for front wheels, and the driveshaft 24 for rear wheels by the pin center,large differential 20. The output of an engine 10 is controlled by the engine control system 26 by drawing 1 operated by the operator according to the amount of treading in of the accelerator pedal which is not shown etc.
[0041] The driving force of the driveshaft 22 for front wheels is transmitted to forward left ring axle 32L and forward right ring axle 32R by the front-wheel differential 30, and, thereby, the rotation drive of front-wheel 34floor line and 34FR on either side is carried out. Similarly, the driving force of the driveshaft 24 for rear wheels is transmitted to left rear ring axle 38L and right rear ring axle 38R by the rear wheel differential 36, and, thereby, the rotation drive of rear wheel 40RL on either side and the 40RR(s) is carried out.
[0042] A torque converter 14, transmission 16, the pin center,large differential 20, the front-wheel differential 30, and the rear wheel differential 36 grade constitute the drive system of a vehicle in this way. Especially the drive system of the operation gestalt of illustration distributes the driving torque of an engine 10 by the fixed allocation ratio to right-and-left front-wheel 34floor line, 34FR and right-and-left rear wheel 40RL, and 40RR, and an engine control system 26 controls the driving torque transmitted to each wheel from an engine 10 in the gross.
[0043] Front-wheel 34floor line on either side, 34FR and rear wheel 40RL on either side, and the damping force of 40RR are

controlled by controlling the braking pressure of wheel-cylinder 46floor line which corresponds by the hydraulic circuit 44 of a damping device 42, 46FR, 46RL, and 46RR. Although not shown in drawing, it is controlled by the electronic control 50 for transit control according to an individual to be controlled by the master cylinder 48 driven according to the treading strength to the brake pedal 47 usually according [the braking pressure of each wheel cylinder] to an operator in the time including a reservoir, an oil pump, various valve gears, etc. in a hydraulic circuit 44, and to explain to a detail later if needed.
[0044] Moreover, front-wheel 34floor line and 34FR on either side are steered with the power steering system 52 for front wheels as shown in drawing 1 . In the operation gestalt of illustration, it has hydraulic power-steering equipment 56 which the power steering system 52 for front wheels answers steering actuation of the steering wheel 54 by the operator, and is driven, and front-wheel 34floor line and 34FR on either side are steered through tie rods 58L and 58R by power-steering equipment 56.
[0045] The actuators 60L and 60R which carry out adjustable control of those effective length, respectively are formed in tie rods 58L and 58R, Actuators 60L and 60R are controlled by the rudder angle control unit 62, and, thereby, the rudder angle of front-wheel 34floor line on either side and 34FR is mutually controlled independently in rear wheel 40RL and 40RR(s).
[0046] Similarly, rear wheel 40RL on either side and 40RR(s) are steered with the power steering system 64 for rear wheels. It has hydraulic power-steering equipment 66 which the power steering system 64 for rear wheels answers the steering actuation of a steering wheel 54 and the vehicle speed by the operator, and is driven, and 40RL(s) of a rear wheel on either side and 40RR(s) are steered through tie rods 68L and 68R by power-steering equipment 66.
[0047] The actuators 70L and 70R which carry out adjustable control of those effective length, respectively are formed in tie rods 68L and 68R, power-steering equipment 66 and Actuators 70L and 70R are controlled by the rudder angle control unit 62, and, thereby, the rudder angle of rear wheel 40RL on either side and 40RR(s) is mutually controlled independently with front-wheel 34floor line and 34FR.
[0048] The power steering system 52 for front wheels, the power steering system 64 for rear wheels, and the rudder angle control unit 62 so that the above explanation may show Each wheel 34floor line, The controllable rudder angle control means is constituted for the rudder angle of 34FR, 40RL, and 40RR according to an individual. An engine 10, an engine control system 26, a damping device 42, and an electronic control 50 have two incomes mutually, and constitute the controllable braking/driving force control means for the braking/driving force of each wheel according to an individual, and an electronic control 50 functions as a control means which controls a rudder angle control means and a braking/driving force control means.
[0049] an electronic control -- 50 -- **** -- a speed sensor -- 72 -- the vehicle speed -- Vx -- being shown -- a signal -- order -- an acceleration sensor -- 74 -- and -- lateral acceleration -- a sensor -- 76 -- respectively -- a vehicle -- 12 -- order -- acceleration -- Gx -- and -- lateral acceleration -- Gy -- being shown -- a signal -- a shift -- a position -- (-- SP --) -- a sensor -- 78 -- transmission -- 16 -- a shift -- a position -- Ps -- being shown -- a signal -- treading strength -- a sensor -- 80 -- a brake pedal -- 47 -- receiving -- treading strength -- Fb (the amount of braking control operation by the operator) -- be shown -- a signal -- inputting -- having -- . In addition, the amount of braking control operation by the operator may be detected by the pressure in a master cylinder 48, or the treading-in stroke of a brake pedal 47.
[0050] Moreover, the signal which shows the signal and the throttle opening Ta (the amount of driving force control operation by the operator) which show an engine speed Ne from an engine control system 26 to an electronic control 50 is inputted, and the signal which shows the steering angle theta (the amount of steering control operation by the operator) through the rudder angle control unit 62 from the steering angle sensor 82 is inputted. In addition, the amount of driving force control operation by the operator may be detected by the treading-in stroke of an accelerator pedal.
[0051] In addition, the order acceleration sensor 74 makes the acceleration direction of a vehicle forward, order acceleration is detected, and the lateral acceleration sensor 76 and the steering angle sensor 82 detect lateral acceleration etc. by making the anticlockwise rotation direction of a vehicle forward. Moreover, the engine control system 26, the electronic control 50, and the rudder angle control unit 62 may consist of the microcomputers and drive circuits which contain CPU, ROM, RAM, and an I/O device, for example, respectively in fact.
[0052] The electronic control 50 for behavior control follows the routine shown in drawing 2 so that it may explain to a detail later. It is first based on the vehicle speed Vx etc. as a target movement quantity of state of a vehicle Target yaw rate gammat of a vehicle, The target lateral acceleration Gyt of a vehicle and the target order acceleration Gxt of a vehicle are calculated. The target order force Fxt of the vehicle corresponding to [as an amount of target internal states of a vehicle] the target order acceleration Gxt of a vehicle based on these, Target slip-angle betat of the target lateral force Fyt of the vehicle corresponding to the target lateral acceleration Gyt, the target yaw moment Mt of the vehicle corresponding to target yaw rate gammat, and a vehicle is calculated.
[0053] Moreover, the electronic control 50 for behavior control is based on the vehicle order acceleration Gx etc., and is the normal load Fzi (i=fl) of each wheel. Calculate fr, rl, and rr and the target generating force Fxyt of a vehicle is calculated as resultant force of the target order force Fxt of a vehicle, and the target lateral force Fyt of a vehicle. By distributing the target generating force Fxyt of a vehicle to each wheel according to the normal load Fzi of each wheel First target generating force Fxyt0i (i=fl, fr, rl, rr) of each wheel which attains the target order force Fxt of a vehicle and the target lateral force Fyt of a vehicle is calculated as force of a direction of meeting in the direction of the target generating force Fxyt of a vehicle.
[0054] The electronic control 50 for behavior control the target generating force Fxyti of each wheel by moreover, the control law made strictly in agreement in the direction of the target generating force Fxyt of a vehicle The amount of amendments of the target generating force of each wheel for attaining only the target yaw moment Mt of a vehicle, That is, second target generating force deltaFxyti (i=fl, fr, rl, rr) of each wheel is calculated, and the target generating force Fxyti of each wheel (i=fl, fr, rl, rr) is calculated as the sum of first target generating force Fxyt0i and second target generating force deltaFxyti.
[0055] Furthermore, target rudder angle deltati of each wheel for the electronic control 50 for behavior control to make the generating force of each wheel the target generating force Fxyti, The target wheel order force Fwxti in the wheel coordinate of each wheel, target slip ratio Sti (i=fl) of each wheel Calculate fr, rl, and rr and target running torque Twti of each wheel is calculated based on the target wheel order force Fwxti and the target slip ratio Sti of each wheel. It is based on target running torque Twti of each wheel, and is the target braking pressure Pti (i=fl) of each wheel. fr, rl, rr, and the target driving torque Tet of an engine 10 are calculated. While outputting a command signal to the rudder angle control device 62 and an engine control system 26 so that rudder angle deltai of each wheel may turn into target rudder angle deltati and the output torque of an engine 10 may turn into the target driving torque Tet, a damping device 42 is controlled so that the braking pressure Pi of each wheel turns into the target braking pressure Pti.
[0056] Next, with reference to the flow chart shown in drawing 2 thru/or drawing 5 , the transit control routine of the vehicle in the first operation gestalt is explained. In addition, closing of the ignition switch which is not shown in drawing begins, and control by the main routine of the flow chart shown in drawing 2 is repeatedly performed for every predetermined time amount.
[0057] Reading of the signal which shows the vehicle speed Vx first detected by the speed sensor 72 in step 50 is performed, and the target lateral acceleration Gyt of target yaw rate gammat of a vehicle and a vehicle and the target order acceleration Gxt of a vehicle

calculate as a target movement quantity of state of a vehicle based on the vehicle speed Vx etc. in step 100.
[0058] For example, target yaw rate gammat sets a steering gear ratio to N, and sets the wheel base of a vehicle to L. It calculates according to the following formula 1, setting a stability factor to Kh and using a steering-yaw rate transient transfer function as H (s). The target lateral acceleration Gyt sets a yaw rate-lateral acceleration transient transfer function to G (s), and calculates it by the following formula 2. The target order acceleration Gxt Engine-speed Ne, the throttle opening Ta According to the following formula 3, it calculates with the function F for calculating the target order acceleration of a vehicle by making the treading strength Fb to gear ratio Rd of the drive system based on the shift position Ps of transmission 16, and a brake pedal into a variate (Ne, Ta, Rd, Fb).
[0059]
gammat=theta-Vx/{N-L (1+Kh-Vx2)} H (s) .... (1)
Gyt=gamma t-Vx-G (s) .... (2)
Gxt=F (Ne, Ta, Rd, Fb) .... (3)
[0060] In step 150, target slip-angle betat of the target order force Fxt of the vehicle corresponding to the target order acceleration Gxt of a vehicle, the target lateral force Fyt of the vehicle corresponding to the target lateral acceleration Gyt, the target yaw moment Mt of the vehicle corresponding to target yaw rate gammat, and a vehicle calculates as an amount of target internal states of a vehicle.
[0061] Especially the target order force Fxt and the target lateral force Fyt of a vehicle are calculated according to the following formulas 4 and 5, respectively by setting mass of a vehicle to Mv, the target yaw moment Mt sets yaw moment of inertia of a vehicle to Iy, and calculates it according to the following formula 6 by setting the differential value of target yaw rate gammat of a vehicle to gammatd, and target slip-angle betat of a vehicle calculates it according to the following formula 7.
[0062] Fxt=Mv-Gxt .... (4)
Fyt=Mv-Gyt .... (5)
Mt=Iy-gamma td .... (6)
betat=integral(Gyt/Vx-gammat) dt .... (7)
[0063] Distance of the vehicle cross direction between the center of gravity 90 of a vehicle 12 and a front-wheel axle is set to Lf as step 200 is shown in drawing 8 and drawing 11 . Set distance of the vehicle cross direction between the center of gravity of a vehicle, and a rear wheel axle to Lr, and the center-of-gravity height of a vehicle is set to H. According to the following formulas 8-11, the touch-down load Fzi (i=fl, fr, rl, rr) of each wheel calculates, respectively, setting roll rigidity allocation of a front wheel and a rear wheel to Rf and Rr (Rf+Rr=1), respectively, setting the tread of a vehicle to Tr, and using gravitational acceleration as g. In addition, the order acceleration Gx and lateral acceleration Gy in the following formulas 8-11 may be the value presumed based on the vehicle speed Vx etc. or the target order acceleration Gxt, and the target lateral acceleration Gyt.
[0064]
Fzfl=Mv {(g-Lr-Gx-H)/(2L)-Gy-H-Rf/Tr}
.... (8)
Fzfr=Mv {(g-Lr-Gx-H)/(2L)+Gy-H-Rf/Tr}
.... (9)
Fzrl=Mv {(g-Lf+Gx-H)/(2L)-Gy-H-Rr/Tr}
.... (10)
Fzrr=Mv {(g-Lf+Gx-H)/(2L)+Gy-H-Rr/Tr}
.... (11)
[0065] While the target generating force Fxyt of a vehicle calculates according to the following formula 12 in step 250 as resultant force of the target order force Fxt of a vehicle, and the target lateral force Fyt Since the following formula 13 is materialized, according to the following formulas 14-17, the target generating force of each wheel of attaining the target generating force Fxyt of a vehicle, i.e., first target generating force Fxyt0i of each wheel, (i=fl, fr, rl, rr) calculates, without giving the target yaw moment Mt to a vehicle.
[0066]
Fxyt=(Fxt2+Fyt2) 1/2 .... (12)
Fzfl+Fzfr+Fzrl+Fzrr=Mv-g .... (13)
Fxyt0fl=Fxyt-Fzfl/(Mv-g) .... (14)
Fxyt0fr=Fxyt-Fzfr/(Mv-g) .... (15)
Fxyt0rl=Fxyt-Fzrl/(Mv-g) .... (16)
Fxyt0rr=Fxyt-Fzrr/(Mv-g) .... (17)
[0067] In this case, they are Fxt0i and Fyt0i (i=fl), respectively about the component of the vehicle cross direction of target generating force Fxyt0i of each wheel which attains the target generating force Fxyt of a vehicle, and the component of a vehicle longitudinal direction. If it is referred to as fr, rl, and rr, the sum total of the component of the vehicle longitudinal direction of a right-and-left front wheel and a right-and-left rear wheel is set to Fyt0f and Fyt0r, respectively and the sum total of the component of the vehicle cross direction of a forward left rear wheel and a forward right rear wheel is set to Fxt0L and Fxt0R, respectively The force of these sum totals is expressed by the following formulas 18-21, respectively.
[0068]
Fyt0 f=Fyt0 fl+Fyt0fr .... (18)
Fyt0 r=Fyt0 rl+Fyt0rr .... (19)
Fxt0 L=Fxt0 fl+Fxt0rl .... (20)
Fxt0 R=Fxt0 fr+Fxt0rr .... (21)
[0069] Moreover, the touch-down load of a right-and-left front wheel is set to Fzf, the touch-down load of a right-and-left rear wheel is set to Fzr, the touch-down load of a forward left rear wheel is set to FzL, and total force Fyt0f, Fyt0r, Fxt0L, and Fxt0R are expressed by the following formulas 22-25, respectively by setting the touch-down load of a forward right rear wheel to FzR.
Fyt0 f=Fzf-Gyt/g .... (22)
Fyt0 r=Fzr-Gyt/g .... (23)
Fxt0 L=FzL-Gxt/g .... (24)
Fxt0 R=FzR-Gxt/g .... (25)
[0070] In addition, the touch-down load Fzf of the right-and-left front wheel in each above-mentioned formula, the touch-down load Fzr of a right-and-left rear wheel, the touch-down load Fzl of a forward left rear wheel, and the touch-down load Fzr of a forward right rear wheel are expressed by the following formulas 26-29, respectively.
[0071]
Fzf=Fzfl+Fzfr =Mv-g-Lr/L-Mv-Gx-H/L .... (26)

Fzr=Fzrl+Fzrr =Mv-g-Lf/L+Mv-Gx-H/L .... (27)
FzL=Fzfl+Fzrl =Mv-g/2-Mv-Gy-H/Tr .... (28)
FzR=Fzfr+Fzrr =Mv-g/2+Mv-Gy-H/Tr .... (29)
[0072] Furthermore, if the target yaw moment Mt of a vehicle is calculated by the following formula 30 and the above-mentioned formulas 22-25 and formulas 26-29 are substituted for this formula 30, the right-hand side of a formula 30 will be set to 0. Therefore, it turns out that first target generating force Fxyt0i of each wheel called for by the 14 to formula 17 above-mentioned formula does not give the yaw moment to a vehicle.
Mt=Iy-gamma td Tr/[=Lf-Fyt0f-Lr-Fyt0r+ (Fxt0L-Fxt0R) and] 2 .... (30)
[0073] By the control law which makes the target generating force Fxyti of each wheel strictly in agreement in the direction of the target generating force Fxyt of a vehicle according to the routine shown in below-mentioned drawing 3 in step 300, the amount of amendments of the target generating force of each wheel for attaining only the target yaw moment Mt of a vehicle, i.e., second target generating force deltaFxyti of each wheel, (i=fl, fr, rl, rr) calculates.
[0074] The target generating force Fxyti of each wheel (i=fl, fr, rl, rr) calculates as the sum of first target generating force Fxyt0i of each wheel calculated in step 250 according to the following formula 24 in step 350, and second target generating force deltaFxyti of each wheel calculated in step 300.
Fxyti=Fxyt0 i+delta Fxyti .... (31)
[0075] According to the routine shown in below-mentioned drawing 4 in step 600, the target wheel order force Fwxti in target rudder angle deltati of each wheel and the wheel coordinate of each wheel and the target slip ratio Sti (i=fl, fr, rl, rr) of each wheel calculate.
[0076] According to the routine shown in below-mentioned drawing 5 in step 700, the target braking pressure Pti of each wheel and the target driving torque Tet of an engine 10 calculate. In step 800, rudder angle deltai of each wheel turns into target rudder angle deltati. A command signal is outputted to the rudder angle control device 62 and an engine control system 26 so that the output torque of an engine 10 may turn into the target driving torque Tet. Moreover, it is controlled by the target generating force Fxyti in which the generating force of each wheel corresponds by controlling a damping device 42, respectively so that the braking pressure Pi of each wheel turns into the target braking pressure Pti, and it returns to step 50 after an appropriate time.
[0077] In step 310 of the second target generating force deltaFxyti operation routine of each wheel shown in drawing 3 It is Di (i=fl) in the arm length of each yaw moment given to a vehicle 12 by first target generating force Fxyt0i of each wheel calculated in the above-mentioned step 250 around the center of gravity 90 of opposite Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. as shown in drawing 8 . fr, rl, and rr calculate according to the following formulas 32-35.
[0078]
Dfl=|Fyt0fl-Tr/2+Fxt0fl-Lf| .... (32)
Dfr=|-Fyt0 fr-Tr/2+Fxt0 fr-Lf| .... (33)
Drl=|Fyt0 rl-Tr/2-Fxt0 rl-Lr| .... (34)
Drr=|-Fyt0 rr-Tr/2-Fxt0 rr-Lr| .... (35)
[0079] In addition, in drawing 8 and below-mentioned drawing 11 , the circle shown centering on the grounding point Pzi (i=fl, fr, rl, rr) of each wheel shows the size relation of the touch-down load Fzi of each wheel, therefore the size relation of a friction circle.
[0080] Second target generating force deltaFxytfl of the right-and-left front wheel for attaining only the target yaw moment Mt of a vehicle in step 320, Since the following formula 36 will be materialized supposing it sets the sum total of the sum total of deltaFxytfr and second target generating force deltaFxytrl of a right-and-left rear wheel, and deltaFxytrr to deltaFxyt and total force deltaFxyt is distributed according to the touch-down load of a wheel on either side **** km of force deltaFxyt of the sum total in the third formula of the right-hand side of a formula 36 calculates according to the following formula 37.
[0081]
Mt=Iy-gamma td = {(Fzfl-Dfl+Fzfr-Dfr)/(Fzfl+Fzfr)} and deltaFxyt + (Fzrl-Drl+Fzrr-Drr)/(Fzrl+Fzrr)}-deltaFxyt = {(Fzfl-Dfl+Fzfr-Dfr)/(Fzfl+Fzfr) +(Fzrl-Drl+Fzrr-Drr)/(Fzrl+Fzrr)}-deltaFxyt .... (36)
Km=(Fzfl-Dfl+Fzfr-Dfr)/(Fzfl+Fzfr) +(Fzrl-Drl+Fzrr-Drr)/(Fzrl+Fzrr) .... (37)
[0082] Second target generating force deltaFxyti (i=fl, fr, rl, rr) of each wheel for attaining only the target yaw moment Mt of a vehicle according to the following formulas 38-41 in step 330 calculates.
[0083]
deltaFxytfl={Fzfl/(Fzfl+Fzfr)} -deltaFxyt ={Fzfl/(Fzfl+Fzfr)} and Iy-gamma td/km .... (38)
deltaFxytfr={Fzfr/(Fzfl+Fzfr)} -deltaFxyt ={Fzfr/(Fzfl+Fzfr)} and Iy-gamma td/km .... (39)
deltaFxytrl=-{Fzrl/(Fzrl+Fzrr)} -deltaFxyt =-{Fzrl/(Fzrl+Fzrr)} and Iy-gamma td/km .... (40)
deltaFxytrr=-{Fzrr/(Fzrl+Fzrr)} -deltaFxyt =-{Fzrr/(Fzrl+Fzrr)} and Iy-gamma td/km .... (41)
[0084] In step 610 of target rudder angle deltati of each wheel shown in drawing 4 , the target wheel order force Fwxti of each wheel, and the target slip ratio Sti operation routine of each wheel, target advance vectorial angle alphawti (i=fl, fr, rl, rr) of the grounding point of each wheel calculates according to the following formulas 42-45. In addition, target advance vectorial angle alphawti of a grounding point is an include angle which the target travelling direction of the grounding point Pzi of each wheel makes to the cross direction of a vehicle as the forward left ring is shown in drawing 9 .
[0085]
alphawtfl=(betat-Vx+Lf-gammat)/(Vx-Tr-gammat/2) .... (42)
alphawtfr=(betat-Vx+Lf-gammat)/(Vx+Tr-gammat/2) .... (43)
alphawtrl=(betat-Vx-Lr-gammat)/(Vx-Tr-gammat/2) .... (44)
alphawtrr=(betat-Vx-Lr-gammat)/(Vx+Tr-gammat/2) .... (45)
[0086] In step 620, the target touch-down load Fzti of each wheel (i=fl, fr, rl, rr) calculates based on the target order acceleration Gxt and the target lateral acceleration Gyt of a vehicle according to the following formulas 46-49 corresponding to the above-mentioned formulas 8-11, respectively.
[0087]
Fztfl=Mv {(g-Lr-Gxt-H)/(2L)-Gyt-H-Rf/Tr}
.... (46)
Fztfr=Mv {(g-Lr-Gxt-H)/(2L)+Gyt-H-Rf/Tr}
.... (47)
Fztrl=Mv {(g-Lf+Gxt-H)/(2L)-Gyt-H-Rr/Tr}
.... (48)
Fztrr=Mv {(g-Lf+Gxt-H)/(2L)+Gyt-H-Rr/Tr}
.... (49)

[0088] The value Fwxti by which the target generating force Fxyti of each wheel was decomposed into the target order force and target lateral force in the wheel coordinate of each wheel, i.e., the target wheel order force, and the target wheel lateral force Fwyti (i=fl, fr, rl, rr) calculate according to the following formulas 50 and 51, respectively as the forward left ring is shown in drawing 10 in step 630.
[0089]
Fwxti=Fxyti-cos (pi/2-deltati)
= Fxyti-sindeltati .... (50)
Fwyti=Fxyti-sin (pi/2-deltati)
= Fxyti-cosdeltati .... (51)
[0090] In step 640, target slip-angle betawti (i=fl, fr, rl, rr) of each wheel calculates according to the following formula 52 as the sum of grounding point target travelling direction angle alphawti of each wheel, and target rudder angle deltati.
beta wti=alpha wti+delta ti .... (52)
[0091] In step 650, the lateral-force generating forecast Fwyai and the target slip ratio Sti (i=fl, fr, rl, rr) of each wheel calculate by the operation expression based on the tire generating force map or tire model which is not shown in drawing based on the target wheel order force Fwxti of each wheel, target slip-angle betawti of each wheel, and the target touch-down load Fzti of each wheel.
[0092] In step 660, deflection deltaFwyi (i=fl, fr, rl, rr) of the target wheel lateral force Fwyti and the lateral-force generating forecast Fwyai calculates about each wheel according to the following formula 53.
deltaFwyi=Fwyti-Fwyai .... (53)
[0093] Steps 670-690 are performed about each wheel in order of for example, a forward left ring, a forward right ring, a left rear ring, and a right rear ring. Distinction of whether especially in the step 670, the absolute value of deflection deltaFwyi of wheel lateral force is under reference-value deltaFwyo (forward constant), That is, when distinction with unnecessary correction of target rudder angle deltati is performed and negative distinction is performed, it progresses to step 680, and when affirmation distinction is performed, it progresses to the back step 700 at which target rudder angle deltati was set as the value last time in step 675.
[0094] In step 680, the amount deltadeltati of corrections of the target rudder angle of each wheel (i=fl, fr, rl, rr) calculates Ks according to the following formula 54 as a forward constant, and in step 690, target rudder angle deltati (i=fl, fr, rl, rr) of each wheel is corrected to delta ti+deltadeltati, and returns to step 630 after an appropriate time.
Deltadeltati=Ks-delta Fwyi .... (54)
[0095] In the target braking pressure Pti of each wheel shown in drawing 5 , and step 710 of an engine target driving torque Tet operation routine, while the target longitudinal velocity Vwxti of the grounding point of each wheel (i=fl, fr, rl, rr) calculates according to the following formulas 55-58, according to the following formula 59, the target passing speed Vtwti of the rolling direction of each wheel (i=fl, fr, rl, rr) calculates.
[0096]
Vwxtfl=Vx+Tr-gamma/2 .... (55)
Vwxtfr=Vx-Tr-gamma/2 .... (56)
Vwxtrl=Vwxtfl .... (57)
Vwxtrr=Vwxtfr .... (58)
Vtwti=Vwxti (cosdeltati-tanbetawti-sindeltati) .... (59)
[0097] In step 720, Vrwti (i=fl, fr, rl, rr) calculates whenever [target wheel speed / of each wheel] according to the following formula 60 based on the target slip ratio Sti and the target passing speed Vrwti of the rolling direction.
Vrwti=(1-Sti) Vrwti .... (60)
[0098] While the target wheel acceleration Vrwtdi of each wheel (i=fl, fr, rl, rr) calculates as a time amount differential value of Vrwti whenever [target wheel speed] in step 730, the effective radius of a wheel is set to Rw and target running torque Twti (i=fl, fr, rl, rr) of each wheel calculates according to the following formula 61 by setting the rotational inertia moment of a wheel to Iw.
Twti=Fwxti-Rw+Iw-Vrwtdi .... (61)
[0099] When distinction of whether target running torque Twti of all wheels is a negative value, i.e., distinction of whether to be in a situation [wheels / all] to be braked, is performed in step 740 and affirmation distinction is performed, it progresses to step 770, and when negative distinction is performed, it progresses to step 750.
[0100] While the gear ratio Rd of a drive system is called for based on the shift position Ps in step 750 It is Xi (i=fl) about the rate of allocation of the driving torque of the engine 10 to each wheel by the drive system. It is referred to as fr, rl, and rr (0<Xi<0.5, sigmaXi=1), and maximum of the target running torque Twti(s) of four flowers is set to Twtmax. The target driving torque Tet of an engine 10 calculates according to the following formula 62 by setting to Xmax the rate of driving torque allocation of the wheel (the maximum driving torque wheel) whose target running torque is Maximum Twtmax.
Tet=Twtmax-Rd/Xmax .... (62)
[0101] While the target braking pressure Pti of the maximum driving torque wheel is set as 0 in step 760, by setting the transform coefficient of braking pressure and damping torque to Kp, the target braking pressure Pti of each wheel other than the maximum driving torque wheel calculates according to the following formula 63, and progresses to step 800 after an appropriate time.
Pti= (Twtmax-Xi/Xmax-Twti)/Kp .... (63)
[0102] In step 770, it is set as 0, the target braking pressure Pti of each wheel calculates according to the following formula 64 in step 780, and the target driving torque Tet of an engine 10 progresses to step 800 after an appropriate time.
Pti=-Twti/Kp .... (64)
[0103] According to the first operation gestalt of illustration, in step 100, it is based on the vehicle speed Vx etc. in this way. As a target movement quantity of state of a vehicle Target yaw rate gammat of a vehicle, The target lateral acceleration Gyt of a vehicle and the target order acceleration Gxt of a vehicle calculate. The target order force Fxt of the vehicle on step 150 and corresponding to the target order acceleration Gxt of a vehicle as an amount of target internal states of a vehicle, Target slip-angle betat of the target lateral force Fyt of the vehicle corresponding to the target lateral acceleration Gyt, the target yaw moment Mt of the vehicle corresponding to target yaw rate gammat, and a vehicle calculates.
[0104] Moreover, while the normal load Fzi of each wheel calculates in step 200 and the target generating force Fxyt of a vehicle calculates in step 250 as resultant force of the target order force Fxt of a vehicle, and the target lateral force Fyt First target generating force Fxyt0i of each wheel which attains the target generating force Fxyt of a vehicle, without giving the yaw moment to a vehicle calculates. By the control law which makes the target generating force Fxyti of each wheel strictly in agreement in the direction of the target generating force Fxyt of a vehicle in step 300 Second target generating force deltaFxyti of each wheel for attaining only the target yaw moment Mt of a vehicle calculates, and the target generating force Fxyti of each wheel calculates in step 350 as the sum of first target generating force Fxyt0i and second target generating force deltaFxyti.

[0105] Therefore, according to the first operation gestalt of illustration, so that the target order force Fxt, the target lateral force Fyt, and the target yaw moment Mt of a vehicle may be attained certainly So that the target lateral acceleration Gyt of target yaw rate gammat of a vehicle and a vehicle and the target order acceleration Gxt of a vehicle may be attained certainly, if it puts in another way The amount of steering control operation can calculate the target generating force Fxyti of each wheel, and according to an operator by this (steering angle theta), It can be made to run a vehicle stably in the state of movement of the request according to the amount of driving force control operation (throttle opening Ta), and the amount of braking control operation (brake-pedal treading strength Fb).
[0106] Moreover, since the direction of the target generating force Fxyti of all wheels can be completely adjusted in the direction of the target generating force Fxyt of a vehicle, it can prevent certainly that a part of force which each wheel generates acts on the car body of a vehicle 12 vainly as internal stress, and can be made to run a vehicle stably, using most efficiently the force which each wheel generates by this.
[0107] Moreover, target rudder angle deltati of each wheel which attains the target generating force Fxyti of each wheel in step 600 according to the first operation gestalt of illustration, The target wheel order force Fwxti in the wheel coordinate of each wheel and the target slip ratio Sti of each wheel calculate. In step 700, the target braking pressure Pti of each wheel and the engine target driving torque Tet calculate. In step 800, rudder angle deltai of each wheel turns into target rudder angle deltati. A command signal is outputted to the rudder angle control device 62 and an engine control system 26 so that the output torque of an engine 10 may turn into the target driving torque Tet. Moreover, the generating force of each wheel is controlled by the target generating force Fxyti of corresponding, respectively, by controlling a damping device 42 so that the braking pressure Pi of each wheel turns into the target braking pressure Pti.
[0108] Therefore, since according to the first operation gestalt of illustration the rudder angle and braking/driving force of each wheel are controlled so that the generating force of each wheel turns into the target generating force Fxyti of corresponding, respectively In the case of the conventional transit control unit by which only the braking/driving force of a wheel is controlled, it compares. The magnitude of the generating force of each wheel and the control range of a direction can be expanded, the engine performance of a wheel (tire) can be used effectively, and, thereby, the generating force of each wheel can be certainly controlled in the target generating force Fxyti of corresponding.
[0109] Moreover, by carrying out feedforward control of the rudder angle and braking/driving force of each wheel so that the generating force of each wheel may turn into the target generating force Fxyti of corresponding, respectively, like **** according to the first operation gestalt of illustration Since the vehicle order acceleration Gx, lateral acceleration Gy, and the yaw rate gamma are controlled by the target order acceleration Gxt of a vehicle, the target lateral acceleration Gyt, and target yaw rate gammat, respectively In the case of the conventional common transit control unit with which the braking/driving force of each wheel is controlled by feedback control according to an individual so that this deflection becomes small based on the deflection of the target behavior index value of a vehicle, and the actual behavior index value of a vehicle, it compares. Transit movement of a vehicle can be controlled according to the operation by the operator certainly and effectively, without producing problems, such as response delay and hunting.
[0110] Target rudder angle deltati of each wheel for making the generating force of each wheel into the target generating force Fxyti in step 600 especially according to the first operation gestalt of illustration, The target wheel order force Fwxti in the wheel coordinate of each wheel and the target slip ratio Sti of each wheel calculate. While Vrwti calculates whenever [target wheel speed / of each wheel] based on the target slip ratio Sti in steps 710 and 720 and the target wheel acceleration Vrwdti of each wheel calculates in step 730 Since target running torque Twti of each wheel calculates based on the target wheel order force Fwxti of each wheel, and the target wheel acceleration Vrwdti As compared with the case where the target wheel acceleration Vrwdti calculated based on the target slip ratio Sti of each wheel is not taken into consideration, target running torque Twti of each wheel can be calculated correctly.
[0111] Moreover, according to the first operation gestalt of illustration, based on the maximum Twtmax of a driving side, the target driving torque Tet of the engine 10 as a driving source calculates among target running torque Twti(s) of each wheel. Since the target braking pressure Pti calculates based on target running torque Twti of Maximum Twtmax and other wheels about other wheels other than the wheel whose target running torque is max While controlling an engine 10 so that the driving torque turns into the target driving torque Tet, the generating force of each wheel is certainly [easily and] controllable in the target generating force Fxyti by controlling the braking pressure Pi of a wheel besides the above to the target braking pressure Pti.
[0112] Moreover, according to the first operation gestalt of illustration, in step 660, deflection deltaFwyti of the target wheel lateral force Fwyti and the lateral-force generating forecast Fwyati calculates. When the magnitude of deflection deltaFwyti of the target wheel lateral force Fwyti and the lateral-force generating forecast Fwyati is under a reference value in steps 670-690 Target rudder angle deltati of the wheel concerned is set as the last target rudder angle, and when the magnitude of deflection deltaFwyti of the target wheel lateral force Fwyti and the lateral-force generating forecast Fwyati is beyond a reference value Since the value from which the last target rudder angle was corrected in the amount deltadeltati of target rudder angle corrections is set as target rudder angle deltati of the wheel concerned while the amount deltadeltati of target rudder angle corrections calculates based on deflection deltaFwyti, it can calculate certainly, without making target rudder angle deltati of each wheel emit.
[0113] The second operation gestalt drawing 6 is a flow chart which shows the main routine of rudder angle control of each wheel in the second operation gestalt of the transit control device of the four-flower vehicle by this invention, and braking/driving force control. In addition, in drawing 6 , the same step number as the step number attached in drawing 2 is given to the step corresponding to the step shown in drawing 2 .
[0114] Steps 50-250 and steps 600-800 of this operation gestalt are performed like the first above-mentioned operation gestalt. By the control law which distributes the target generating force Fxyt of a vehicle in proportion to the touch-down load of each wheel strictly according to the routine shown in drawing 7 in step 400 performed by the degree of step 250 The correction factor Kr to the resultant force Fm of the generating force (second target generating force) of each wheel for attaining only the target yaw moment Mt of a vehicle, the target basic generating force Fbxyti of each wheel (i=fl, fr, rl, rr), and the target basic generating force of each wheel calculates.
[0115] In step 550, the target generating force Fxyti of each wheel calculates as a product of a correction factor Kr and the target basic generating force Fbxyti according to the following formula 65, and progresses to step 600 after an appropriate time.
Fxyti=Kr-Fbxyti .... (65)
[0116] In step 410 of the resultant force Fm of the second target generating force of each wheel shown in drawing 7 , the target basic generating force Fbxyti of a vehicle, and a correction factor Kr operation routine Distinction of whether the product of the vehicle order acceleration Gx and the lateral acceleration Gy of a vehicle is 0, That is, when distinction of whether the vehicle order acceleration Gx or the lateral acceleration Gy of a vehicle is 0 is performed and negative distinction is performed, it progresses to step 450, and when affirmation distinction is performed, it progresses to step 420.
[0117] So that the wheel which attains the target yaw moment Mt of a vehicle by vector rotation of the wheel generating force in step

420 may be specified as a right-and-left front wheel and a right-and-left rear wheel While j which shows the wheel by which vector rotation of the wheel generating force is carried out is set as fl, fr, rl, and rr Include-angle thetaj (j=fl, fr, rl, rr) which the vector of target generating force Fxyt0i of each wheel makes to the segment which connects the grounding point Pzi of each wheel and the center of gravity 90 of a vehicle as the case where j is fr and rl is shown in drawing 11 calculates according to the following formulas 66-69.
[0118]
thetafl=tan-1|Fxt0 fl/Fyt0fl|-tan-1|2 Lf/Tr| .... (66)
thetafr=tan-1|Fxt0 fr/Fyt0fr|-tan-1|2 Lf/Tr| .... (67)
thetarl=tan-1|Fxt0 rl/Fyt0rl|-tan-1|2 Lr/Tr| .... (68)
thetarr=tan-1|Fxt0 rr/Fyt0rr|-tan-1|2 Lr/Tr| .... (69)
[0119] The resultant force Fm for generating only the target yaw moment Mt of a vehicle according to the following formula 70 in step 430, i.e., the resultant force of the second target generating force of four flowers specified in step 420, calculates.
[0120]
[Equation 1]

$$Fm = Iy \cdot \gamma t / \sum_{i=j} \cos\theta i \quad \cdots\cdots (70)$$

[0121] In step 440, the target basic generating force Fbxyti of each wheel (i=fl, fr, rl, rr) calculates according to the following formulas 71-74.
Fbxytfl=(Fxyt0fl2+Fm2) 1/2 .... (71)
Fbxytfr=(Fxyt0fr2+Fm2) 1/2 .... (72)
Fbxytrl=(Fxyt0rl2+Fm2) 1/2 .... (73)
Fbxytrr=(Fxyt0rr2+Fm2) 1/2 .... (74)
[0122] When distinction of whether the product of the vehicle order acceleration Gx and the lateral acceleration Gy of a vehicle is a forward value is performed in step 450 and negative distinction is performed, it progresses to step 490, and when affirmation distinction is performed, it progresses to step 460. In addition, the vehicle order acceleration used for the product of steps 410 and 450 and lateral acceleration may be values presumed based on the vehicle speed Vx etc., and may be the target order acceleration Gxt and the target lateral acceleration Gyt.
[0123] So that the wheel which attains the target yaw moment Mt of a vehicle by vector rotation of the wheel generating force in step 460 may be specified as a forward left ring and a right rear ring While j which shows the wheel by which vector rotation of the wheel generating force is carried out is set as fl and rr and k which shows the wheel by which vector rotation of the wheel generating force is not carried out is set as fr and rl Include-angle thetaj (j=fl, rr) which the vector of target generating force Fxyt0fl of a forward left ring and a right rear ring and Fxyt0rr makes to the segment which connects the grounding points Pzfl and Pzrr of a forward left ring and a right rear ring and the center of gravity 90 of a vehicle calculates according to the above-mentioned formulas 66 and 69.
[0124] Resultant force of the second target generating force of the resultant force Fm for generating the target yaw moment Mt of a vehicle according to the above-mentioned formula 70 in step 470, i.e., a forward left ring, and a right rear ring calculates, and the target basic generating force Fbxyti of each wheel calculates according to the following formulas 75-78 in step 480.
[0125]
Fbxytfl=(Fxyt0fl2+Fm2) 1/2 .... (75)
Fbxytfr=Fxyt0fr .... (76)
Fbxytrl=Fxyt0rl .... (77)
Fbxytrr=(Fxyt0rr2+Fm2) 1/2 .... (78)
[0126] While j is set as fr and rl and k is set as fl and rr so that the wheel which attains the target yaw moment Mt of a vehicle by vector rotation of the generating force of a wheel in step 490 may be specified as a forward right ring and a left rear ring Include-angle thetaj which the vector of target generating force Fxyt0fr of a forward right ring and a left rear ring and Fxyt0rl makes to the segment which connects the grounding points Pzfr and Pzrl of a forward right ring and a left rear ring, and the center of gravity 90 of a vehicle as shown in drawing 10 (j=fr) rl) calculates according to the above-mentioned formulas 67 and 68.
[0127] Resultant force of the second target generating force of the resultant force Fm for generating the target yaw moment Mt of a vehicle according to the above-mentioned formula 70 in step 500, i.e., a forward right ring, and a left rear ring calculates, and the target basic generating force Fbxyti of each wheel calculates according to the following formulas 79-82 in step 510.
[0128]
Fbxytfl=Fxyt0fl .... (79)
Fbxytfr=(Fxyt0fr2+Fm2) 1/2 .... (80)
Fbxytrl=(Fxyt0rl2+Fm2) 1/2 .... (81)
Fbxytrr=Fxyt0rr .... (82)
[0129] In addition, in the above-mentioned step 430,470,500, since resultant force Fm cannot be attained even if it carries out vector rotation of minimum value Fxyt0min of the first target generating force by setting to Fxyt0min the minimum value of first target generating force Fxyt0j of the wheel specified in step 420, when it is |Fm|>|Fxyt0min|, resultant force Fm is set as Fxyt0min.
[0130] A correction factor Kr calculates as a value with which the following formula 83 is filled in step 520.
[0131]
[Equation 2]

$$Kr\left\{\sum_{i=j}\sqrt{Fxyti^2-\left(\frac{Fm}{Kr}\right)^2}+\sum_{i=k}Fxyti\right\}=Fxyt \quad \cdots\cdots (83)$$

[0132] According to the second operation gestalt of illustration, in this way by the control law which distributes the target generating force Fxyt of a vehicle in proportion to the touch-down load of each wheel strictly in step 400 The resultant force Fm of the second target generating force for attaining only the target yaw moment Mt of a vehicle, The correction factor Kr to the target basic generating force Fbxyti of each wheel and the target basic generating force of each wheel calculates, and the target generating force Fxyti of each wheel calculates as a product of a correction factor Kr and the target basic generating force Fbxyti in step 550.
[0133] Therefore, since the target generating force Fxyti of each wheel will be calculated so that it may be proportional to the magnitude of the friction circle of each wheel strictly if it puts in another way so that it may be proportional to the touch-down load of

each wheel strictly, the marginal margin to the force which each wheel may generate can be made into max, and, thereby, the force generating capacity of each wheel can be demonstrated to the maximum extent.
[0134] According to the second operation gestalt of illustration, in steps 410, 420, 450, 460, and 490, it is especially based on the sign of product Gx-Gy of the vehicle order acceleration Gx and the lateral acceleration Gy of a vehicle. If it puts in another way, based on the direction of the target generating force Fxyt of a vehicle, two wheels which attain the target yaw moment Mt of a vehicle efficiently by vector rotation of the wheel generating force are specified. The resultant force Fm of the second target generating force for generating only the target yaw moment Mt about the vehicle specified in step 430,470,500 calculates. In steps 440, 480, and 510, the target basic generating force Fbxyti of each wheel calculates based on the resultant force Fm of first target generating force Fxyt0i of each wheel, and the second target generating force. When the magnitude of the target basic generating force Fbxyti is amended by the correction factor Kr in step 550, the target generating force Fxyti of each wheel calculates.
[0135] When the resultant force Fm of the second target generating force calculates about one wheel or all wheels irrespective of the direction of the target generating force Fxyt of a vehicle According to the second operation gestalt of illustration, to the direction of the target generating force Fxyti of all wheels becoming in the different direction from the direction of the target generating force Fxyt of a vehicle Since the target generating force Fxyti of two wheels other than the specified wheel surely becomes the same as that of the direction of the target generating force Fxyt of a vehicle The force of acting on the car body of a vehicle vainly as internal stress as compared with the case where the resultant force Fm of the second target generating force calculates, about one wheel or all wheels can be reduced.
[0136] In addition, according to the second operation gestalt of illustration, since steps 50-250 and steps 600-800 are performed like the case of the first above-mentioned operation gestalt, the same operation effectiveness as the above-mentioned operation effectiveness of the first operation gestalt acquired by these steps can be acquired.
[0137] Although this invention was explained to the detail about the specific operation gestalt above, probably this invention will not be limited to an above-mentioned operation gestalt, and it will be clear for this contractor its for other various operation gestalten to be possible within the limits of this invention.
[0138] For example, in the operation gestalt of illustration, a vehicle 12 has the drive system which transmits the engine 10 as a driving source, and the driving torque of a driving source to each wheel by the fixed allocation ratio. The driving force control means which controls the driving force of all wheels in the gross when a braking/driving force control means controls the driving torque of an engine 10 (engine control system 26), Although it consists of a controllable damping force control means (a damping device 42 and electronic control 50) according to the individual, the damping force of each wheel By constituting a vehicle, for example as the so-called vehicle of a wheel in motor type, a driving force control means is controllable according to an individual in the driving force of each wheel, and it may be constituted so that a damping force control means may be controllable according to an individual in the damping force of each wheel.
[0139] Moreover, in the first operation gestalt of illustration, although each wheel is steered by carrying out adjustable control of the effective length of the tie rods 58L, 58L, 68L, and 68R of the hydraulic power-steering equipments 56 and 66 by Actuators 60L, 60L, 70L, and 70R, each wheel may be constituted so that it may be steered with the power steering system respectively prepared according to the individual.
[0140] Moreover, in the first operation gestalt of illustration, although all are deltaFxyt(s), the sum total of the sum total of second target generating force deltaFxytfl of the right-and-left front wheel for attaining only the target yaw moment Mt of a vehicle, and deltaFxytfr and second target generating force deltaFxytrl of a right-and-left rear wheel, and deltaFxytrr Second target generating force deltaFxytfl of the right-and-left front wheel for attaining only the target yaw moment Mt of a vehicle, Set the sum total of deltaFxytfr to deltaFxytf and the sum total of second target generating force deltaFxytrl of a right-and-left rear wheel and deltaFxytrr is set to deltaFxytr. As long as deltaFxytf and deltaFxytr have fixed relation mutually, deltaFxytf and deltaFxytr may be calculated as a value which is mutually different.
[0141] for example, the ratio of the distance Lr of the vehicle cross direction between the centers of gravity of a vehicle and rear wheel axles -- it may be set up so that it may become Lr/Lf. [as opposed to / in the ratio of deltaFxytf / as opposed to deltaFxytr in sum total deltaFxytf of the second target generating force of a front wheel, and sum total deltaFxytr of the second target generating force of a rear wheel / Lf for the distance of the vehicle cross direction between the center of gravity of a vehicle, and a front-wheel axle]
[0142] In this case, the above-mentioned formula 36 and a formula 37 become as the following formula 84 and a formula 85, respectively.
Mt=Iy-gamma td ={(Fzfl-Dfl+Fzfr-Dfr)/(Fzfl+Fzfr)} and deltaFxytf +(Fzrl-Drl+Fzrr-Drr)/(Fzrl+Fzrr)} -deltaFxytr ={(Fzfl-Dfl+Fzfr-Dfr)/(Fzfl+Fzfr) +(Fzrl-Drl+Fzrr-Drr)/(Fzrl+Fzrr)}
- L/LrdeltaFxytf .... (84)
Km={(Fzfl-Dfl+Fzfr-Dfr)/(Fzfl+Fzfr) +(Fzrl-Drl+Fzrr-Drr)/(Fzrl+Fzrr)} (L/Lr)
.... (85)
[0143] Therefore, second target generating force deltaFxyti (i=fl, fr, rl, rr) of each wheel for attaining only the target yaw moment Mt of a vehicle is calculated according to the following formulas 86-89.
[0144]
deltaFxytfl={Fzfl/(Fzfl+Fzfr)} -deltaFxytf ={Fzfl/(Fzfl+Fzfr)} and Iy-gamma td/km .... (86)
deltaFxytfr={Fzfr/(Fzfl+Fzfr)} -deltaFxytf ={Fzfr/(Fzfl+Fzfr)} and Iy-gamma td/km .... (87)
deltaFxytrl=-{Fzrl/(Fzrl+Fzrr)} -deltaFxytr =-{Fzrl/(Fzrl+Fzrr)} and Iy-gamma td (L/Lr)/Km .... (88)
deltaFxytrr=-{Fzrr/(Fzrl+Fzrr)} -deltaFxytr =-{Fzrr/(Fzrl+Fzrr)} and Iy-gamma td (L/Lr)/Km .... (89)
[0145]
[Effect of the Invention] According to the configuration of claim 1 of this invention, so that more clearly than the above explanation It is based on the amount of steering control operation by the operator, the amount of driving force control operation, and the amount of damping force control operation. The target order force of a vehicle, Since the rudder angle and braking/driving torque of each wheel are controlled so that the target lateral force of a vehicle and the target yaw moment of a vehicle calculate and the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle are attained by the generating force of each wheel As compared with the case where only the braking/driving force of each wheel is controlled, the magnitude of the generating force of each wheel and the control range of a direction are expanded. The engine performance of a wheel (tire) can be used effectively, transit movement of a vehicle can be certainly controlled according to an operator's operation by this, and the performance traverse of a vehicle can be raised.
[0146] Moreover, by carrying out feedforward control of the rudder angle and braking/driving force of each wheel so that the generating force of each wheel may turn into the target generating force of corresponding, respectively according to the configuration of claim 1 Since the vehicle order force, lateral force, and the yaw moment are controlled by the target order force of a vehicle, target

lateral force, and the target yaw moment, respectively In the case of the conventional common transit control unit with which the braking/driving force of each wheel is controlled by feedback control according to an individual so that this deflection becomes small based on the deflection of the target behavior index value of a vehicle, and the actual behavior index value of a vehicle, it compares. Transit movement of a vehicle is effectively [certainly and] controllable according to the operation by the operator.

[0147] Moreover, while the direction of resultant force of the target generating force of each wheel meets towards resultant force of the target order force of a vehicle, and the target lateral force of a vehicle according to the configuration of claim 2 Since the magnitude and the direction of the target generating force of each wheel are determined that the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle are attained by resultant force of the target generating force of each wheel The magnitude and the direction of the target generating force of each wheel can be determined that the target order force of a vehicle, the target lateral force of a vehicle, and the target yaw moment of a vehicle are efficiently attained by the generating force of each wheel. Therefore, it can prevent certainly that a part of force which each wheel generates acts on the car body of a vehicle vainly as internal stress, and can be made to run a vehicle stably, using most efficiently the force which each wheel generates by this.

[0148] Moreover, the first target generating force of each wheel for attaining the target order force of a vehicle, and the target lateral force of a vehicle according to the configuration of claim 3, without giving the target yaw moment to a vehicle, Since the target generating force of each wheel calculates as the sum with the second target generating force of each wheel for attaining only the target yaw moment, the target generating force of each wheel can be calculated so that the target order force of a vehicle, target lateral force, and the target yaw moment may be attained certainly.

[0149] Moreover, the second target generating force of each wheel attain the target yaw moment can be calculated certainly, without [without the direction of resultant force of the target generating force of each wheel breaks down the relation which meets towards resultant force of the target order force of a vehicle, and the target lateral force of a vehicle according to the configuration of claim 4, and] breaking down greatly the relation in which the target generating force of each wheel is proportional to the touch-down load of each wheel.

[0150] Moreover, the target generating force of each wheel for attaining the target order force of a vehicle, target lateral force, and the target yaw moment can calculate certainly, without according to the configuration of claim 5, the direction of resultant force of the target generating force of each wheel breaking down the relation which meets towards resultant force of the target order force of a vehicle, and the target lateral force of a vehicle, while the target generating force of each wheel is proportional to the touch-down load of each wheel completely.

[0151] Moreover, according to the configuration of claim 6, as a wheel made suitable for generating the second target generating force efficiently, since a wheel with the larger arm length of the yaw moment of the circumference of the center of gravity of the vehicle by the target generating force of [second] the wheels on either side is specified As compared with the case where other wheels are specified, the magnitude of the second target generating force may be small, therefore the amount of amendments to the magnitude of the target generating force of the specified wheel and the target generating force of wheels other than the specified wheel can be made small.

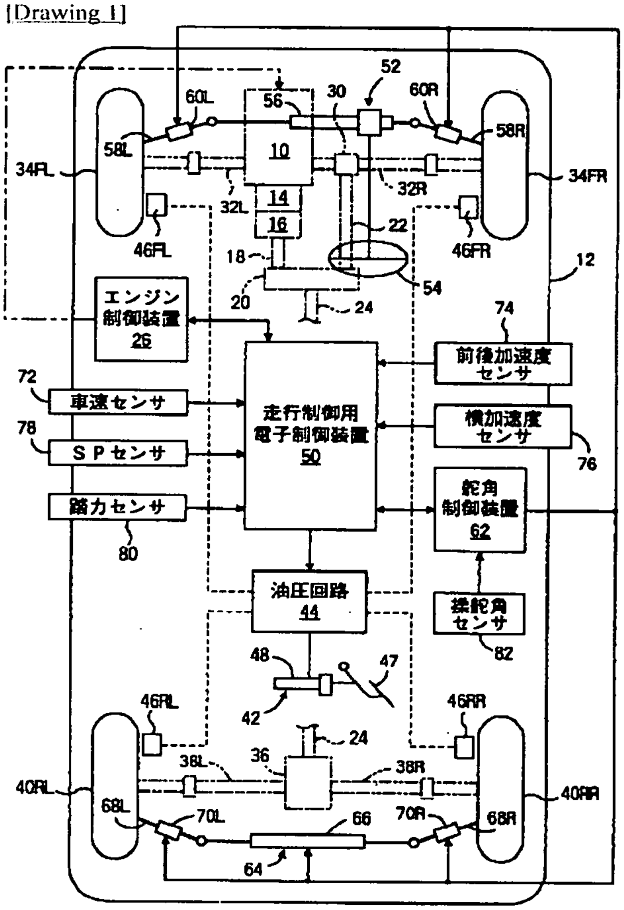
[0152] Moreover, by certainly being able to adjust the direction of the target generating force of the wheel which is not specified towards resultant force of the target order force of a vehicle, and target lateral force, therefore specifying one wheel or all wheels While being able to calculate the target generating force of each wheel easily as compared with the case where the direction of the target generating force of all wheels differs from the direction of resultant force of the target order force of a vehicle, and target lateral force A part of force generated by the wheel can reduce certainly extent which acts on a vehicle vainly as internal stress.

[0153] Moreover, according to the configuration of claim 7, the target rudder angle of each wheel for attaining the target generating force of each wheel and the target braking/driving torque of each wheel can be calculated certainly, and it can calculate certainly according to the configuration of claim 8, without making the target rudder angle of each wheel emit.

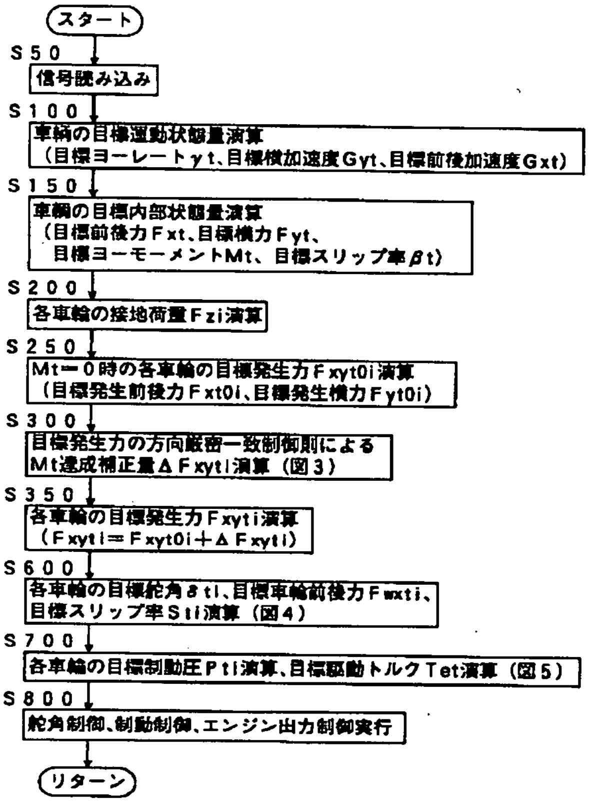
[Translation done.]

DRAWINGS

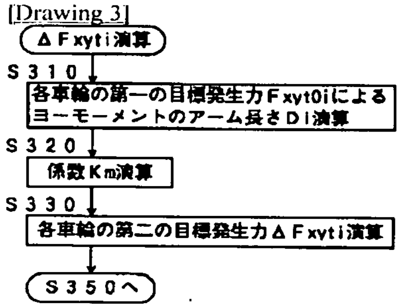
[Drawing 1]



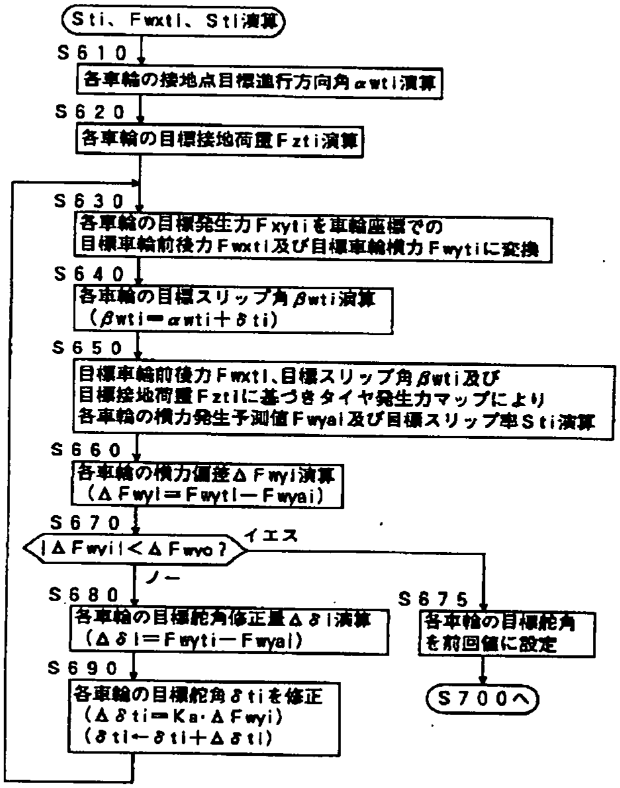
[Drawing 2]



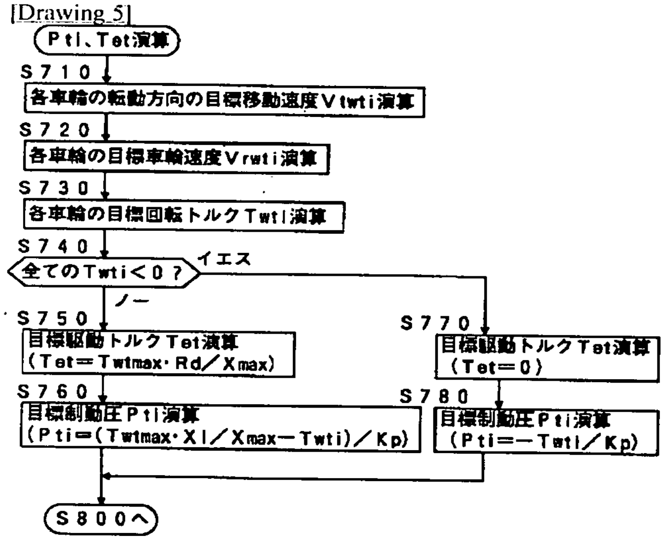
[Drawing 3]



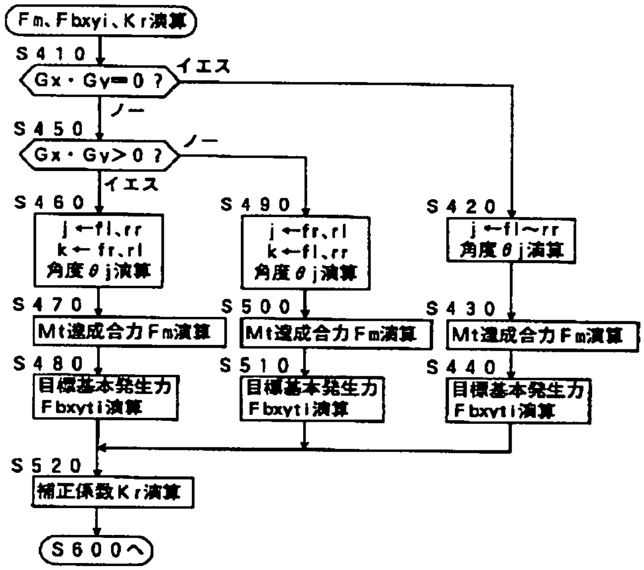
[Drawing 4]



[Drawing 5]



[Drawing 7]



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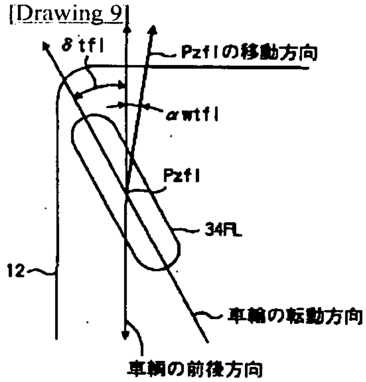

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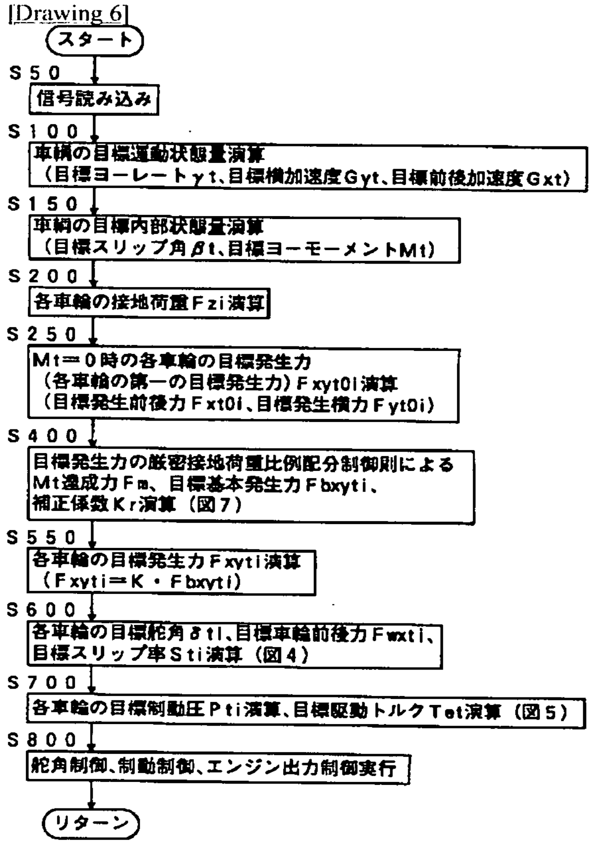

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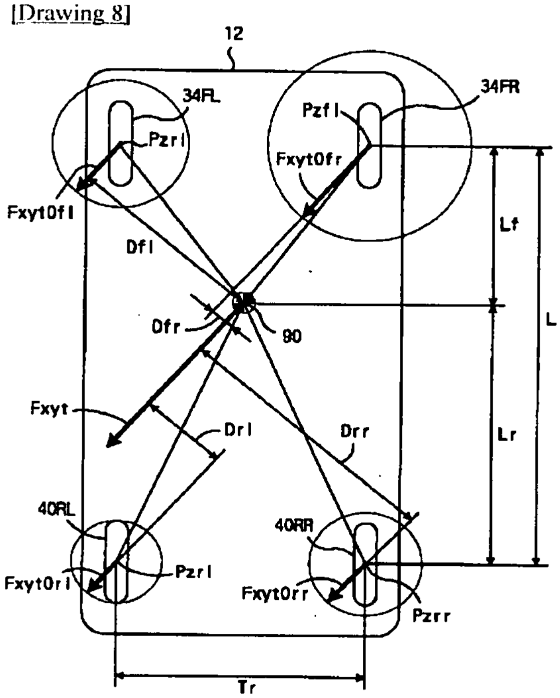

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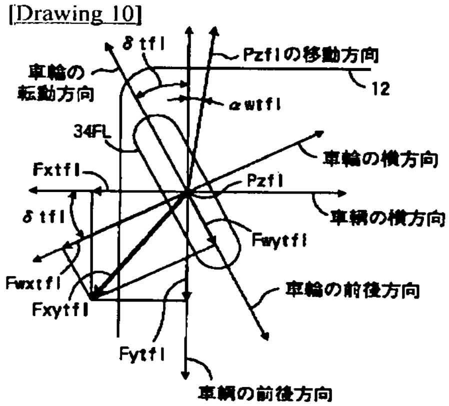

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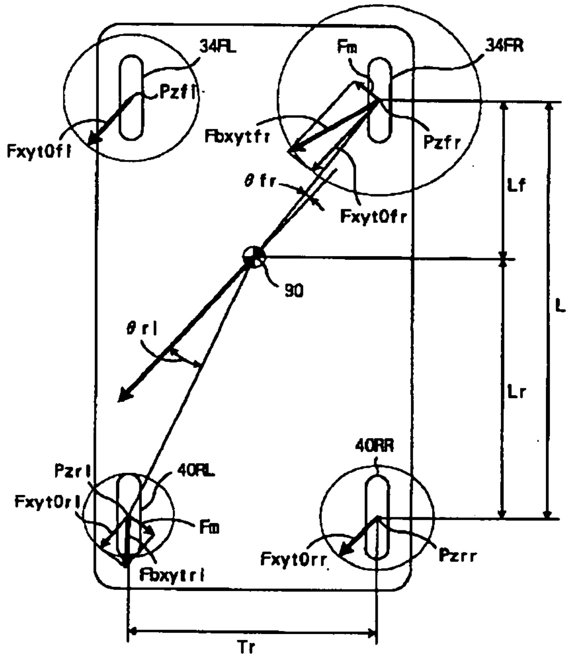

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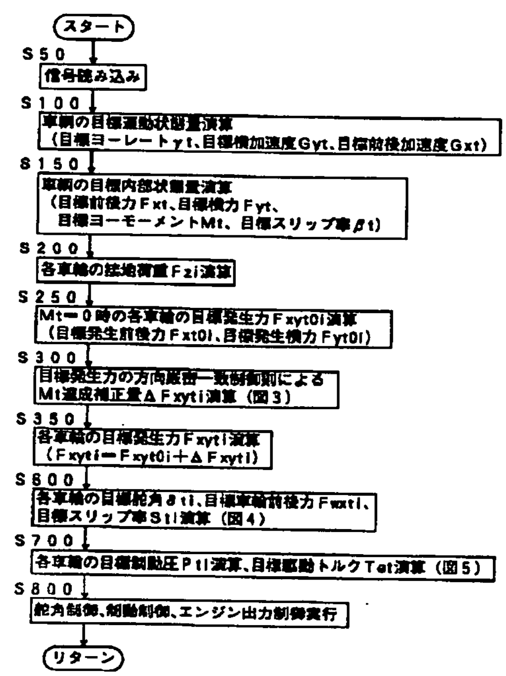
(54)【発明の名称】　車輌の走行制御装置

(57)【要約】
【課題】　各車輪の舵角をも制御対象として各車輪の発生力を制御することにより、従来の走行制御装置の場合よりも車輌の走行性を向上させる。
【解決手段】　車輌の目標前後力Ｆxt、目標横力Ｆyt、目標ヨーモーメントＭtが演算され（Ｓ１００、１５０）、車輌にヨーモーメントを与えることなく目標前後力Ｆxt及び目標横力Ｆytを達成する各車輪の第一の目標発生力Ｆxyt0iが演算され（Ｓ２００、２５０）、車輌の目標ヨーモーメントＭtのみを達成するための各車輪の第二の目標発生力ΔＦxytiが演算され（Ｓ３００）、Ｆxyt0iとΔＦxytiとの和として各車輪の目標発生力Ｆxytiが演算される（Ｓ３５０）。そして目標発生力Ｆxytiを達成する各車輪の目標舵角δti、目標車輪前後力Ｆwxti、目標スリップ率Ｓtiが演算され（Ｓ６００）、各車輪の目標制動圧Ｐti及びエンジンの目標駆動トルクＴetが演算され（Ｓ７００）、各車輪の舵角が目標舵角δtiになり、エンジン１０の出力トルクが目標駆動トルクＴetになり、各車輪の制動圧が目標制動圧Ｐtiになるよう制御される（Ｓ８００）。



【特許請求の範囲】

【請求項１】それぞれ各車輪の舵角及び制駆動力を個別に制御可能な舵角制御手段及び制駆動力制御手段を備えた車輌の走行制御装置にして、運転者による操舵制御操作量を検出する手段と、運転者による駆動力制御操作量を検出する手段と、運転者による制動力制御操作量を検出する手段と、運転者による操舵制御操作量、駆動力制御操作量、制動力制御操作量に基づき車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントを演算する車輌目標状態量演算手段と、前記目標前後力、前記目標横力、前記目標ヨーモーメントに基づき各車輪の目標発生力を演算する車輪目標発生力演算手段と、前記各車輪の目標発生力に基づき各車輪の目標舵角及び目標制駆動トルクを演算する車輪目標制御量演算手段と、各車輪の舵角及び制駆動トルクがそれぞれ前記目標舵角及び前記目標制駆動トルクになるよう前記舵角制御手段及び前記制駆動力制御手段を制御する制御手段とを有することを特徴とする車輌の走行制御装置。

【請求項２】前記車輪目標発生力演算手段は前記各車輪の目標発生力の合力の方向が前記車輌の目標前後力と前記車輌の目標横力との合力の方向に沿うと共に、前記各車輪の目標発生力の合力により前記車輌の目標前後力、前記車輌の目標横力、前記車輌の目標ヨーモーメントが達成されるよう前記各車輪の目標発生力の大きさ及び方向を決定することを特徴とする請求項１に記載の車輌の走行制御装置。

【請求項３】前記車輪目標発生力演算手段は車輌に前記目標ヨーモーメントを与えることなく前記車輌の目標前後力及び前記車輌の目標横力を達成するための各車輪の第一の目標発生力を演算する第一の目標発生力演算手段と、前記目標ヨーモーメントのみを達成するための各車輪の第二の目標発生力を演算する第二の目標発生力演算手段とを有し、前記第一の目標発生力と前記第二の目標発生力との和として前記各車輪の目標発生力を演算することを特徴とする請求項２に記載の車輌の走行制御装置。

【請求項４】前記車輌は左右前輪及び左右後輪を有し、前記車輪目標発生力演算手段は各車輪の接地荷重を求める手段を有し、前記第一の目標発生力演算手段は前記車輌の目標前後力と前記車輌の目標横力との合力を各車輪の接地荷重に比例して各車輪に配分することにより前記各車輪の第一の目標発生力を演算し、前記第二の目標発生力演算手段は前記目標ヨーモーメント及び前記車輌の目標前後力と前記車輌の目標横力との合力の方向に基づき前記目標ヨーモーメントのみを達成するために左右前輪が発生すべき力の合計として前輪のヨーモーメント発生力を演算すると共に左右後輪が発生すべき力の合計として前記前輪のヨーモーメント発生力に対し一定の関係をなす後輪のヨーモーメント発生力を演算する手段と、前記前輪のヨーモーメント発生力を左右前輪の接地荷重に比例して左右前輪に配分すると共に前記後輪のヨーモーメント発生力を左右後輪の接地荷重に比例して左右後輪に配分することにより前記各車輪の第二の目標発生力を演算する手段とを有することを特徴とする請求項３に記載の車輌の走行制御装置。

【請求項５】前記車輪目標発生力演算手段は各車輪の接地荷重を求める手段を有し、前記第一の目標発生力演算手段は前記車輌の目標前後力と前記車輌の目標横力との合力を各車輪の接地荷重に比例して各車輪に配分することにより前記各車輪の第一の目標発生力を演算し、前記第二の目標発生力演算手段は前記車輌の目標前後力及び前記車輌の目標横力に基づき前記第二の目標発生力を効率的に発生させるに適した車輪を特定する車輪特定手段と、前記特定された車輪について前記第一の目標発生力に垂直な方向の力として前記第二の目標発生力を演算する手段とを有し、前記車輪目標発生力演算手段は前記特定された車輪の目標発生力を前記第一の目標発生力と前記第二の目標発生力との合力に設定する手段と、前記特定された車輪以外の車輪の目標発生力を対応する前記第一の目標発生力に設定する手段と、前記特定された車輪の前記目標発生力と前記特定された車輪以外の車輪の前記目標発生力との合力が前記車輌の目標前後力及び前記車輌の目標横力を達成するよう前記特定された車輪の前記目標発生力及び前記特定された車輪以外の車輪の前記目標発生力の大きさを補正する手段とを有することを特徴とする請求項３に記載の車輌の走行制御装置。

【請求項６】前記車輪特定手段は、前記第二の目標発生力を効率的に発生させるに適した車輪として、左右の車輪のうち前記第二の目標発生力による車輌の重心周りのヨーモーメントのアーム長さが大きい方の車輪を特定することを特徴とする請求項６に記載の車輌の走行制御装置。

【請求項７】前記車輪目標制御量演算手段は車輌の前後方向に対する各車輪の接地点の目標進行方向角を演算する手段と、各車輪の目標接地荷重を演算する手段と、前記目標発生力及び前回の目標舵角に基づき各車輪の車輪座標に於ける目標車輪前後力及び目標車輪横力を演算する手段と、前記各車輪の接地点の目標進行方向角と前回の目標舵角との和として各車輪の目標スリップ角を演算する手段と、前記各車輪の目標車輪前後力、前記各車輪の目標スリップ角、前記各車輪の目標接地荷重に基づき各車輪の横力発生予測値及び目標スリップ率を演算する手段と、前記各車輪の目標車輪前後力、前記各車輪の目標車輪横力、前記各車輪の横力発生予測値、前記各車輪の目標スリップ率に基づき各車輪の目標舵角及び目標回転トルクを演算する手段とを有することを特徴とする請求項１に記載の車輌の走行制御装置。

【請求項８】前記各車輪の目標舵角及び目標回転トルクを演算する手段は、前記目標車輪横力と前記横力発生予測値との偏差の大きさが基準値未満であるときには、各

車輪の目標舵角を前回の目標舵角に設定し、前記目標車輪横力と前記横力発生予測値との偏差の大きさが基準値以上であるときには、前記目標車輪横力と前記横力発生予測値との偏差に基づき目標舵角修正量を演算すると共に、前回の目標舵角が前記目標舵角修正量にて修正された値を各車輪の目標舵角に設定することを特徴とする請求項７に記載の車輌の走行制御装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、車輌の走行制御装置に係り、更に詳細には各車輪の舵角及び制駆動力を個別に制御可能な車輌の走行制御装置に係る。

【０００２】

【従来の技術】自動車等の車輌の走行制御装置の一つとして、例えば特表平１１－５００３８０号公表公報に記載されている如く、車輌モデル及びタイヤモデルに基づいて各車輪の制動力を個別に制御することによって車輌のヨーモーメントを制御するよう構成された走行制御装置が従来より知られている。この種の走行制御装置によれば、車輌のヨーモーメントが制御されない場合に比して車輌を安定的に走行させることができる。

【０００３】

【発明が解決しようとする課題】一般に、車輌の走行運動は車輌の前後力、横力、ヨーモーメントによって規定され、車輌の前後力、横力、ヨーモーメントは各車輪が路面に対し発生する力の大きさ及び方向により決定される。また車輌を運転者の運転操作に応じて適正に且つ安定的に走行させるためには、車輌の前後力、横力、ヨーモーメントが運転者の操舵制御操作、駆動力制御操作、制動力制御操作に対応する目標値に制御されなければならず、従って車輌の前後力、横力、ヨーモーメントが目標値になるよう、各車輪が路面に対し発生する力の大きさ及び方向が制御されなければならない。

【０００４】しかるに上述の如き従来の走行制御装置に於いては、操舵輪の舵角が運転者の操舵制御操作に対応する舵角であり非操舵輪の舵角は一定不変であることを前提として、車輪の制駆動力しか制御されないため、各車輪が発生する力の大きさ及び方向の制御範囲に限界があり、車輪（タイヤ）の性能を最大限に発揮させることができず、従って従来の走行制御装置には車輌の走行性を向上させる点で改善の余地がある。

【０００５】また従来の一般的な走行制御装置に於いては、車輌の目標挙動指標値と車輌の実際の挙動指標値との偏差に基づき該偏差が小さくなるようフィードバック制御により各車輪の制駆動力が個別に制御されるようになっており、車輌の実際の挙動が目標挙動よりずれたことに対処すべく走行制御が行われ、またハンチング防止等の制御の安定性確保の必要からフィードバックゲインを高くすることができないため、車輌の走行運動を確実に且つ効果的に制御することができず、従って従来の一般的な走行制御装置にも車輌の走行性を向上させる点で改善の余地がある。

【０００６】本発明は、各車輪の制駆動力を制御することにより車輌の走行運動を制御するよう構成された従来の走行制御装置に於ける上述の如き問題に鑑みてなされたものであり、本発明の主要な課題は、各車輪の舵角をも制御対象とし各車輪が発生する力の大きさ及び方向の制御範囲を拡大すると共に、運転者の運転操作に対応する適正な車輌の走行運動を達成するに必要な大きさ及び方向になるよう各車輪が発生する力の大きさ及び方向を制御することにより、従来の走行制御装置の場合に比して車輌の走行性を向上させることである。

【０００７】

【課題を解決するための手段】上述の主要な課題は、本発明によれば、請求項１の構成、即ちそれぞれ各車輪の舵角及び制駆動力を個別に制御可能な舵角制御手段及び制駆動力制御手段を備えた車輌の走行制御装置にして、運転者による操舵制御操作量を検出する手段と、運転者による駆動力制御操作量を検出する手段と、運転者による制動力制御操作量を検出する手段と、運転者による操舵制御操作量、駆動力制御操作量、制動力制御操作量に基づき車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントを演算する車輌目標状態量演算手段と、前記目標前後力、前記目標横力、前記目標ヨーモーメントに基づき各車輪の目標発生力を演算する車輪目標発生力演算手段と、前記各車輪の目標発生力に基づき各車輪の目標舵角及び目標制駆動力を演算する車輪目標制御量演算手段と、各車輪の舵角及び制駆動力がそれぞれ前記目標舵角及び前記目標制駆動力になるよう前記舵角制御手段及び前記制駆動力制御手段を制御する制御手段とを有することを特徴とする車輌の走行制御装置によって達成される。

【０００８】上記請求項１の構成によれば、車輌は各車輪の舵角を個別に制御可能な舵角制御手段を備え、運転者による操舵制御操作量、駆動力制御操作量、制動力制御操作量に基づき車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが演算され、車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントに基づき各車輪の目標発生力が演算され、各車輪の目標発生力に基づき各車輪の目標舵角及び目標制駆動トルクが演算され、各車輪の舵角及び制駆動トルクがそれぞれ目標舵角及び目標制駆動トルクになるよう制御されるので、各車輪の発生力により車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが達成されるよう各車輪の舵角及び制駆動トルクが制御され、これにより各車輪の制駆動力のみが制御される場合に比して確実に車輌の走行性が向上する。

【０００９】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項１の構成に於いて、前記車輪目標発生力演算手段は前記各車輪の目標発生力の

合力の方向が前記車輌の目標前後力と前記車輌の目標横力との合力の方向に沿うと共に、前記各車輪の目標発生力の合力により前記車輌の目標前後力、前記車輌の目標横力、前記車輌の目標ヨーモーメントが達成されるよう前記各車輪の目標発生力の大きさ及び方向を決定するよう構成される（請求項２の構成）。

【００１０】請求項２の構成によれば、各車輪の目標発生力の合力の方向が車輌の目標前後力及び車輌の目標横力の合力の方向に沿うと共に、各車輪の目標発生力の合力により車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが達成されるよう各車輪の目標発生力の大きさ及び方向が決定されるので、各車輪の発生力により車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが効率的に達成されるよう各車輪の目標発生力の大きさ及び方向が決定される。

【００１１】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項２の構成に於いて、前記車輪目標発生力演算手段は車輌に前記目標ヨーモーメントを与えることなく前記車輌の目標前後力及び前記車輌の目標横力を達成するための各車輪の第一の目標発生力を演算する第一の目標発生力演算手段と、前記目標ヨーモーメントのみを達成するための各車輪の第二の目標発生力を演算する第二の目標発生力演算手段とを有し、前記第一の目標発生力と前記第二の目標発生力との和として前記各車輪の目標発生力を演算するよう構成される（請求項３の構成）。

【００１２】請求項３の構成によれば、車輌に目標ヨーモーメントを与えることなく車輌の目標前後力及び車輌の目標横力を達成するための各車輪の第一の目標発生力が演算され、目標ヨーモーメントのみを達成するための各車輪の第二の目標発生力が演算され、第一の目標発生力と第二の目標発生力との和として各車輪の目標発生力が演算されるので、車輌の目標前後力、目標横力、目標ヨーモーメントが確実に達成されるよう各車輪の目標発生力が演算される。

【００１３】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項３の構成に於いて、前記車輌は左右前輪及び左右後輪を有し、前記車輪目標発生力演算手段は各車輪の接地荷重を求める手段を有し、前記第一の目標発生力演算手段は前記車輌の目標前後力と前記車輌の目標横力との合力を各車輪の接地荷重に比例して各車輪に配分することにより前記各車輪の第一の目標発生力を演算し、前記第二の目標発生力演算手段は前記目標ヨーモーメント及び前記車輌の目標前後力と前記車輌の目標横力との合力の方向に基づき前記目標ヨーモーメントのみを達成するために左右前輪が発生すべき力の合計として前輪のヨーモーメント発生力を演算すると共に左右後輪が発生すべき力の合計として前記前輪のヨーモーメント発生力に対し一定の関係をなす後輪のヨーモーメント発生力を演算する手段と、前記前輪のヨーモーメント発生力を左右前輪の接地荷重に比例して左右前輪に配分すると共に前記後輪のヨーモーメント発生力を左右後輪の接地荷重に比例して左右後輪に配分することにより前記各車輪の第二の目標発生力を演算する手段とを有するよう構成される（請求項４の構成）。

【００１４】請求項４の構成によれば、各車輪の接地荷重が求められ、車輌の目標前後力と車輌の目標横力との合力が各車輪の接地荷重に比例して各車輪に配分されることにより各車輪の第一の目標発生力が演算され、目標ヨーモーメント及び車輌の目標前後力と車輌の目標横力との合力の方向に基づき目標ヨーモーメントのみを達成するために左右前輪が発生すべき力の合計として前輪のヨーモーメント発生力が演算されると共に左右後輪が発生すべき力の合計として前輪のヨーモーメント発生力に対し一定の関係をなす後輪のヨーモーメント発生力が演算され、前輪のヨーモーメント発生力が左右前輪の接地荷重に比例して左右前輪に配分されると共に後輪のヨーモーメント発生力が左右後輪の接地荷重に比例して左右後輪に配分されることにより各車輪の第二の目標発生力が演算されるので、各車輪の目標発生力の合力の方向が車輌の目標前後力及び車輌の目標横力の合力の方向に沿う関係を崩すことなく、また各車輪の目標発生力が各車輪の接地荷重に比例する関係を大きく崩すことなく、目標ヨーモーメントを達成する各車輪の第二の目標発生力が確実に演算される。

【００１５】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項３の構成に於いて、前記車輪目標発生力演算手段は各車輪の接地荷重を求める手段を有し、前記第一の目標発生力演算手段は前記車輌の目標前後力と前記車輌の目標横力との合力を各車輪の接地荷重に比例して各車輪に配分することにより前記各車輪の第一の目標発生力を演算し、前記第二の目標発生力演算手段は前記車輌の目標前後力及び前記車輌の目標横力に基づき前記第二の目標発生力を効率的に発生させるに適した車輪を特定する車輪特定手段と、前記特定された車輪について前記第一の目標発生力に垂直な方向の力として前記第二の目標発生力を演算する手段とを有し、前記車輪目標発生力演算手段は前記特定された車輪の目標発生力を前記第一の目標発生力と前記第二の目標発生力との合力に設定する手段と、前記特定された車輪以外の車輪の目標発生力を対応する前記第一の目標発生力に設定する手段と、前記特定された車輪の前記目標発生力と前記特定された車輪以外の車輪の前記目標発生力との合力が前記車輌の目標前後力及び前記車輌の目標横力を達成するよう前記特定された車輪の前記目標発生力及び前記特定された車輪以外の車輪の前記目標発生力の大きさを補正する手段とを有するよう構成される（請求項５の構成）。

【００１６】請求項５の構成によれば、各車輪の接地荷重が求められ、車輌の目標前後力と車輌の目標横力との

合力が各車輪の接地荷重に比例して各車輪に配分されることにより各車輪の第一の目標発生力が演算され、車輌の目標前後力及び車輌の目標横力に基づき第二の目標発生力を効率的に発生させるに適した車輪が特定され、該特定された車輪について第一の目標発生力に垂直な方向の力として第二の目標発生力が演算され、特定された車輪の目標発生力が第一の目標発生力と第二の目標発生力との合力に設定され、特定された車輪以外の車輪の目標発生力が対応する第一の目標発生力に設定され、特定された車輪の目標発生力と特定された車輪以外の車輪の目標発生力との合力が車輌の目標前後力及び車輌の目標横力を達成するよう各車輪の目標発生力の大きさが補正されるので、各車輪の目標発生力が完全に各車輪の接地荷重に比例すると共に各車輪の目標発生力の合力の方向が車輌の目標前後力及び車輌の目標横力の合力の方向に沿う関係を崩すことなく、車輌の目標前後力、目標横力、目標ヨーモーメントを達成するための各車輪の目標発生力が確実に演算される。

【００１７】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項５の構成に於いて、前記車輪特定手段は、前記第二の目標発生力を効率的に発生させるに適した車輪として、左右の車輪のうち前記第二の目標発生力による車輌の重心周りのヨーモーメントのアーム長さが大きい方の車輪を特定するよう構成される（請求項６の構成）。

【００１８】請求項６の構成によれば、第二の目標発生力を効率的に発生させるに適した車輪として、左右の車輪のうち第二の目標発生力による車輌の重心周りのヨーモーメントのアーム長さが大きい方の車輪が特定されるので、他の車輪が特定される場合に比して第二の目標発生力の大きさが小さくてよく、これにより特定された車輪の目標発生力及び特定された車輪以外の車輪の目標発生力の大きさに対する補正量も小さくなる。

【００１９】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項１の構成に於いて、前記車輪目標制御量演算手段は車輌の前後方向に対する各車輪の接地点の目標進行方向角を演算する手段と、各車輪の目標接地荷重を演算する手段と、前記目標発生力及び前回の目標舵角に基づき各車輪の車輪座標に於ける目標車輪前後力及び目標車輪横力を演算する手段と、前記各車輪の接地点の目標進行方向角と前回の目標舵角との和として各車輪の目標スリップ角を演算する手段と、前記各車輪の目標車輪前後力、前記各車輪の目標スリップ角、前記各車輪の目標接地荷重に基づき各車輪の横力発生予測値及び目標スリップ率を演算する手段と、前記各車輪の目標車輪前後力、前記各車輪の目標車輪横力、前記各車輪の横力発生予測値、前記各車輪の目標スリップ率に基づき各車輪の目標舵角及び目標回転トルクを演算する手段とを有するよう構成される（請求項７の構成）。

【００２０】請求項７の構成によれば、車輌の前後方向に対する各車輪の接地点の目標進行方向角が演算され、各車輪の目標接地荷重が演算され、目標発生力及び前回の目標舵角に基づき各車輪の車輪座標に於ける目標車輪前後力及び目標車輪横力が演算され、各車輪の接地点の目標進行方向角と前回の目標舵角との和として各車輪の目標スリップ角が演算され、各車輪の目標車輪前後力、各車輪の目標スリップ角、各車輪の目標接地荷重に基づき各車輪の横力発生予測値及び目標スリップ率が演算され、各車輪の目標車輪前後力、各車輪の目標車輪横力、各車輪の横力発生予測値、各車輪の目標スリップ率に基づき各車輪の目標舵角及び目標回転トルクが演算されるので、各車輪の目標発生力を達成するための各車輪の目標舵角及び各車輪の目標制駆動トルクが確実に演算される。

【００２１】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項７の構成に於いて、前記各車輪の目標舵角及び目標回転トルクを演算する手段は、前記目標車輪横力と前記横力発生予測値との偏差の大きさが基準値未満であるときには、各車輪の目標舵角を前回の目標舵角に設定し、前記目標車輪横力と前記横力発生予測値との偏差の大きさが基準値以上であるときには、前記目標車輪横力と前記横力発生予測値との偏差に基づき目標舵角修正量を演算すると共に、前回の目標舵角が前記目標舵角修正量にて修正された値を各車輪の目標舵角に設定するよう構成される（請求項８の構成）。

【００２２】請求項８の構成によれば、目標車輪横力と横力発生予測値との偏差の大きさが基準値未満であるときには、当該車輪の目標舵角が前回の目標舵角に設定され、目標車輪横力と横力発生予測値との偏差の大きさが基準値以上であるときには、目標車輪横力と横力発生予測値との偏差に基づき目標舵角修正量が演算されると共に、前回の目標舵角が目標舵角修正量にて修正された値が当該車輪の目標舵角に設定されるので、各車輪の目標舵角が発散することなく確実に演算される。

【００２３】

【課題解決手段の好ましい態様】本発明の一つの好ましい態様によれば、上記請求項１の構成に於いて、車輌目標状態量演算手段は運転者による操舵制御操作量、駆動力制御操作量、制動力制御操作量に基づき車輌の目標前後加速度、車輌の目標横加速度、車輌の目標ヨーレートを演算し、車輌の目標前後加速度、車輌の目標横加速度、車輌の目標ヨーレートに基づきそれぞれ車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントを演算するよう構成される（好ましい態様１）。

【００２４】本発明の他の一つの好ましい態様によれば、上記請求項１の構成に於いて、制駆動力制御手段は駆動力制御手段と制動力制御手段とよりなるよう構成される（好ましい態様２）。

【００２５】本発明の他の一つの好ましい態様によれば、上記好ましい態様２の構成に於いて、駆動力制御手段は全ての車輪の駆動力を総括的に制御し、制動力制御手段は各車輪の制動力を個別に制御可能であるよう構成される（好ましい態様３）。

【００２６】本発明の他の一つの好ましい態様によれば、上記好ましい態様２の構成に於いて、駆動力制御手段は各車輪の駆動力を個別に制御可能であり、制動力制御手段は各車輪の制動力を個別に制御可能であるよう構成される（好ましい態様４）。

【００２７】本発明の他の一つの好ましい態様によれば、上記請求項１の構成に於いて、車輌は左右前輪及び左右後輪を有する四輪車輌であるよう構成される（好ましい態様５）。

【００２８】本発明の他の一つの好ましい態様によれば、上記請求項４の構成に於いて、前輪のヨーモーメント発生力及び後輪のヨーモーメント発生力は同一の値であるよう構成される（好ましい態様６）。

【００２９】本発明の他の一つの好ましい態様によれば、上記請求項４の構成に於いて、車輌の重心と前輪車軸との間の車輌前後方向の距離をＬｆとし、車輌の重心と後輪車軸との間の車輌前後方向の距離をＬｒとして、後輪のヨーモーメント発生力の大きさに対する前輪のヨーモーメント発生力の大きさの比はＬｒ／Ｌｆであるよう構成される（好ましい態様７）。

【００３０】本発明の他の一つの好ましい態様によれば、上記請求項４の構成に於いて、各車輪の接地荷重を求める手段は車輌の質量、車輌の前後加速度、車輌の横加速度に基づき推定により各車輪の接地荷重を演算するよう構成される（好ましい態様８）。

【００３１】本発明の他の一つの好ましい態様によれば、上記請求項５の構成に於いて、車輌は左右前輪及び左右後輪を有する四輪車輌であり、車輪特定手段は車輌の目標前後力及び車輌の目標横力が０でないときには、車輌の目標前後力の方向及び車輌の目標横力の方向に基づき左前輪及び右後輪又は右前輪及び左後輪の二つの車輪を特定するよう構成される（好ましい態様９）。

【００３２】本発明の他の一つの好ましい態様によれば、上記請求項５の構成に於いて、車輌は左右前輪及び左右後輪を有する四輪車輌であり、車輪特定手段は車輌の目標前後力若しくは車輌の目標横力が０であるときには、全ての車輪を特定するよう構成される（好ましい態様１０）。

【００３３】本発明の他の一つの好ましい態様によれば、上記好ましい態様９又は１０の構成に於いて、第二の目標発生力を演算する手段は演算された第二の目標発生力の大きさが特定された車輪の第一の目標発生力の大きさよりも大きいときには、第二の目標発生力の大きさを当該車輪の第一の目標発生力の大きさに補正するよう構成される（好ましい態様１１）。

【００３４】本発明の他の一つの好ましい態様によれば、上記請求項７の構成に於いて、車輌は駆動源と駆動源の駆動トルクを各車輪へ一定の配分比率にて伝達する駆動系とを有し、制駆動力制御手段は駆動源の駆動トルクを制御することにより全ての車輪の駆動力を総括的に制御する駆動力制御手段と、各車輪の制動力を個別に制御可能である制動力制御手段とよりなり、前記制御手段は各車輪の目標回転トルクのうち駆動側の最大値に基づき駆動源の目標駆動トルクを演算し、目標回転トルクが最大である車輪以外の他の車輪について前記最大値及び他の車輪の目標回転トルクに基づき目標制動力制御量を演算するよう構成される（好ましい態様１２）。

【００３５】本発明の他の一つの好ましい態様によれば、上記請求項７の構成に於いて、各車輪の目標舵角及び目標回転トルクを演算する手段は各車輪の目標車輪横力及び横力発生予測値に基づき各車輪の目標舵角の修正量を演算し、前回の目標舵角と目標舵角の修正量との和として各車輪の目標舵角を演算するよう構成される（好ましい態様１３）。

【００３６】本発明の他の一つの好ましい態様によれば、上記請求項７の構成に於いて、各車輪の目標舵角及び目標回転トルクを演算する手段は各車輪の目標スリップ率に基づき各車輪の目標車輪加速度を演算し、各車輪の目標車輪前後力に基づく第一の目標回転トルクと各車輪の目標車輪加速度に基づく第二の目標回転トルクとの和として各車輪の目標回転トルクを演算するよう構成される（好ましい態様１４）。

【００３７】本発明の他の一つの好ましい態様によれば、上記請求項８の構成に於いて、各車輪の目標舵角及び目標回転トルクを演算する手段は目標車輪横力と横力発生予測値との偏差に比例する値として目標舵角修正量を演算するよう構成される（好ましい態様１５）。

【００３８】

【発明の実施の形態】以下に添付の図を参照しつつ、本発明を幾つかの好ましい実施形態について詳細に説明する。

【００３９】第一の実施形態

図１は本発明による車輌の走行制御装置の第一の実施形態を示す概略構成図である。

【００４０】図１に於いて、１０は車輌１２に搭載された駆動源としてのエンジンを示しており、エンジン１０の駆動力はトルクコンバータ１４及びトランスミッション１６を介して出力軸１８へ伝達され、出力軸１８の駆動力はセンターディファレンシャル２０により前輪用プロペラシャフト２２及び後輪用プロペラシャフト２４へ伝達される。エンジン１０の出力は運転者により操作される図１には示されていないアクセルペダルの踏み込み量等に応じてエンジン制御装置２６により制御される。

【００４１】前輪用プロペラシャフト２２の駆動力は前輪ディファレンシャル３０により左前輪車軸３２L及び

右前輪車軸３２Ｒへ伝達され、これにより左右の前輪３４FL及び３４FRが回転駆動される。同様に後輪用プロペラシャフト２４の駆動力は後輪ディファレンシャル３６により左後輪車軸３８L及び右後輪車軸３８Ｒへ伝達され、これにより左右の後輪４０RL及び４０RRが回転駆動される。

【００４２】かくしてトルクコンバータ１４、トランスミッション１６、センターディファレンシャル２０、前輪ディファレンシャル３０、後輪ディファレンシャル３６等は車輌の駆動系を構成している。特に図示の実施形態の駆動系は左右前輪３４FL、３４FR及び左右後輪４０RL、４０RRに対し一定の配分比率にてエンジン１０の駆動トルクを配分し、エンジン制御装置２６はエンジン１０より各車輪へ伝達される駆動トルクを総括的に制御する。

【００４３】左右の前輪３４FL、３４FR及び左右の後輪４０RL、４０RRの制動力は制動装置４２の油圧回路４４により対応するホイールシリンダ４６FL、４６FR、４６RL、４６RRの制動圧が制御されることによって制御される。図には示されていないが、油圧回路４４はリザーバ、オイルポンプ、種々の弁装置等を含み、各ホイールシリンダの制動圧は通常時には運転者によるブレーキペダル４７に対する踏力に応じて駆動されるマスタシリンダ４８により制御され、また必要に応じて後に詳細に説明する如く走行制御用電子制御装置５０により個別に制御される。

【００４４】また図１に示されている如く、左右の前輪３４FL及び３４FRは前輪用操舵装置５２により操舵される。図示の実施形態に於いては、前輪用操舵装置５２は運転者によるステアリングホイール５４の操舵操作に応答して駆動される油圧式のパワーステアリング装置５６を有し、左右の前輪３４FL及び３４FRはパワーステアリング装置５６によりタイロッド５８L及び５８Ｒを介して操舵される。

【００４５】タイロッド５８L及び５８Ｒにはそれぞれそれらの有効長さを可変制御するアクチュエータ６０L及び６０Ｒが設けられており、アクチュエータ６０L及び６０Ｒは舵角制御装置６２により制御され、これにより左右の前輪３４FL及び３４FRの舵角は相互に独立して、また後輪４０RL及び４０RRとは独立して制御されるようになっている。

【００４６】同様に、左右の後輪４０RL及び４０RRは後輪用操舵装置６４により操舵される。後輪用操舵装置６４は運転者によるステアリングホイール５４の操舵操作や車速に応答して駆動される油圧式のパワーステアリング装置６６を有し、左右の後輪の４０RL及び４０RRはパワーステアリング装置６６によりタイロッド６８L及び６８Ｒを介して操舵される。

【００４７】タイロッド６８L及び６８Ｒにはそれぞれそれらの有効長さを可変制御するアクチュエータ７０L及び７０Ｒが設けられており、パワーステアリング装置６６及びアクチュエータ７０L、７０Ｒは舵角制御装置６２により制御され、これにより左右の後輪４０RL及び４０RRの舵角は相互に独立して、また前輪３４FL及び３４FRとは独立して制御されるようになっている。

【００４８】以上の説明より解る如く、前輪用操舵装置５２、後輪用操舵装置６４、舵角制御装置６２は各車輪３４FL、３４FR、４０RL、４０RRの舵角を個別に制御可能な舵角制御手段を構成しており、エンジン１０、エンジン制御装置２６、制動装置４２、電子制御装置５０は互いに共働して各車輪の制駆動力を個別に制御可能な制駆動力制御手段を構成しており、電子制御装置５０は舵角制御手段及び制駆動力制御手段を制御する制御手段として機能する。

【００４９】電子制御装置５０には車速センサ７２より車速Ｖxを示す信号、前後加速度センサ７４及び横加速度センサ７６よりそれぞれ車輌１２の前後加速度Ｇx及び横加速度Ｇyを示す信号、シフトポジション（ＳＰ）センサ７８よりトランスミッション１６のシフトポジションＰsを示す信号、踏力センサ８０よりブレーキペダル４７に対する踏力Ｆｂ（運転者による制動制御操作量）を示す信号が入力される。尚運転者による制動制御操作量はマスタシリンダ４８内の圧力又はブレーキペダル４７の踏み込みストロークにより検出されてもよい。

【００５０】また電子制御装置５０にはエンジン制御装置２６よりエンジン回転数Ｎeを示す信号及びスロットル開度Ｔａ（運転者による駆動力制御操作量）を示す信号が入力され、操舵角センサ８２より舵角制御装置６２を経て操舵角θ（運転者による操舵制御操作量）を示す信号が入力される。尚運転者による駆動力制御操作量はアクセルペダルの踏み込みストロークにより検出されてもよい。

【００５１】尚前後加速度センサ７４は車輌の加速方向を正として前後加速度を検出し、横加速度センサ７６及び操舵角センサ８２は車輌の左旋回方向を正として横加速度等を検出する。またエンジン制御装置２６、電子制御装置５０、舵角制御装置６２は実際にはそれぞれ例えばＣＰＵ、ＲＯＭ、ＲＡＭ、入出力装置を含むマイクロコンピュータ及び駆動回路にて構成されていてよい。

【００５２】後に詳細に説明する如く、挙動制御用電子制御装置５０は図２に示されたルーチンに従って、まず車速Ｖx等に基づき車輌の目標運動状態量として車輌の目標ヨーレートγt、車輌の目標横加速度Ｇyt、車輌の目標前後加速度Ｇxtを演算し、これらに基づき車輌の目標内部状態量として車輌の目標前後加速度Ｇxtに対応する車輌の目標前後力Ｆxt、目標横加速度Ｇytに対応する車輌の目標横力Ｆyt、目標ヨーレートγtに対応する車輌の目標ヨーモーメントＭt、車輌の目標スリップ角βｔを演算する。

【００５３】また挙動制御用電子制御装置５０は、車輌

の前後加速度G_x等に基づき各車輪の垂直荷重F_{zi}（i＝fl、fr、rl、rr）を演算し、車輌の目標前後力F_{xt}及び車輌の目標横力F_{yt}の合力として車輌の目標発生力F_{xyt}を演算し、車輌の目標発生力F_{xyt}を各車輪の垂直荷重F_{zi}に応じて各車輪に配分することにより、車輌の目標前後力F_{xt}及び車輌の目標横力F_{yt}を達成する各車輪の第一の目標発生力F_{xyt0i}（i＝fl、fr、rl、rr）を車輌の目標発生力F_{xyt}の方向に沿う方向の力として演算する。

【００５４】また挙動制御用電子制御装置５０は、各車輪の目標発生力F_{xyti}を車輌の目標発生力F_{xyt}の方向に厳密に一致させる制御則により、車輌の目標ヨーモーメントM_tのみを達成するための各車輪の目標発生力の補正量、即ち各車輪の第二の目標発生力ΔF_{xyti}（i＝fl、fr、rl、rr）を演算し、第一の目標発生力F_{xyt0i}と第二の目標発生力ΔF_{xyti}との和として各車輪の目標発生力F_{xyti}（i＝fl、fr、rl、rr）を演算する。

【００５５】更に挙動制御用電子制御装置５０は、各車輪の発生力を目標発生力F_{xyti}とするための各車輪の目標舵角δ_{ti}、各車輪の車輪座標に於ける目標車輪前後力F_{wxti}、各車輪の目標スリップ率S_{ti}（i＝fl、fr、rl、rr）を演算し、各車輪の目標車輪前後力F_{wxti}及び目標スリップ率S_{ti}に基づき各車輪の目標回転トルクT_{wti}を演算し、各車輪の目標回転トルクT_{wti}に基づき各車輪の目標制動圧P_{ti}（i＝fl、fr、rl、rr）及びエンジン１０の目標駆動トルクT_{et}を演算し、各車輪の舵角δ_iが目標舵角δ_{ti}になり、エンジン１０の出力トルクが目標駆動トルクT_{et}になるよう舵角制御装置６２及びエンジン制御装置２６へ指令信号を出力すると共に、各車輪の制動圧P_iが目標制動圧P_{ti}になるよう制動装置４２を制御する。

【００５６】次に図２乃至図５に示されたフローチャートを参照して第一の実施形態に於ける車輌の走行制御ルーチンについて説明する。尚図２に示されたフローチャートのメインルーチンによる制御は図には示されていないイグニッションスイッチの閉成により開始され、所定の時間毎に繰返し実行される。

【００５７】まずステップ５０に於いては車速センサ７２により検出された車速V_xを示す信号等の読み込みが行われ、ステップ１００に於いては車速V_x等に基づき車輌の目標運動状態量として車輌の目標ヨーレートγ_t、車輌の目標横加速度G_{yt}、車輌の目標前後加速度G_{xt}が演算される。

【００５８】例えば目標ヨーレートγ_tはステアリングギヤ比をNとし、車輌のホイールベースをLとし、スタビリティファクタをK_hとし、操舵－ヨーレート過渡伝達関数をH(s)として下記の式１に従って演算され、目標横加速度G_{yt}はヨーレート－横加速度過渡伝達関数をG(s)として下記の式２により演算され、目標前後加速度G_{xt}はエンジン回転数N_e、スロットル開度T_a、トランスミッション１６のシフトポジションP_sに基づく駆動系のギヤ比R_d、ブレーキペダルに対する踏力F_bを変量として車輌の目標前後加速度を演算するための関数F（N_e, T_a, R_d, F_b）により下記の式３に従って演算される。

【００５９】

$$\gamma_t=\theta\cdot V_x/\{N\cdot L(1+K_h\cdot V_x^2)\}\,H(s) \quad \cdots\cdots(1)$$

$$G_{yt}=\gamma_t\cdot V_x\cdot G(s) \quad \cdots\cdots(2)$$

$$G_{xt}=F(N_e,\ T_a,\ R_d,\ F_b) \quad \cdots\cdots(3)$$

【００６０】ステップ１５０に於いては車輌の目標内部状態量として車輌の目標前後加速度G_{xt}に対応する車輌の目標前後力F_{xt}、目標横加速度G_{yt}に対応する車輌の目標横力F_{yt}、目標ヨーレートγ_tに対応する車輌の目標ヨーモーメントM_t、車輌の目標スリップ角β_tが演算される。

【００６１】特に車輌の目標前後力F_{xt}及び目標横力F_{yt}は車輌の質量をM_vとしてそれぞれ下記の式４及び５に従って演算され、目標ヨーモーメントM_tは車輌のヨー慣性モーメントをI_yとし、車輌の目標ヨーレートγ_tの微分値をγ_{td}として下記の式６に従って演算され、車輌の目標スリップ角β_tは下記の式７に従って演算される。

【００６２】

$$F_{xt}=M_v\cdot G_{xt} \quad \cdots\cdots(4)$$

$$F_{yt}=M_v\cdot G_{yt} \quad \cdots\cdots(5)$$

$$M_t=I_y\cdot\gamma_{td} \quad \cdots\cdots(6)$$

$$\beta_t=\int(G_{yt}/V_x-\gamma_t)\,dt \quad \cdots\cdots(7)$$

【００６３】ステップ２００に於いては図８及び図１１に示されている如く車輌１２の重心９０と前輪車軸との間の車輌前後方向の距離をL_fとし、車輌の重心と後輪車軸との間の車輌前後方向の距離をL_rとし、車輌の重心高さをHとし、前輪及び後輪のロール剛性配分をそれぞれR_f及びR_r（$R_f+R_r=1$）とし、車輌のトレッドをT_rとし、重力加速度をgとして、それぞれ下記の式８～１１に従って各車輪の接地荷重F_{zi}(i＝fl、fr、rl、rr）が演算される。尚下記の式８～１１に於ける前後加速度G_x及び横加速度G_yは車速V_x等に基づいて推定される値又は目標前後加速度G_{xt}及び目標横加速度G_{yt}であってよい。

【００６４】

$$F_{zfl}=M_v\{(g\cdot L_r-G_x\cdot H)/(2L)-G_y\cdot H\cdot R_f/T_r\} \quad \cdots\cdots(8)$$

$$F_{zfr}=M_v\{(g\cdot L_r-G_x\cdot H)/(2L)+G_y\cdot H\cdot R_f/T_r\} \quad \cdots\cdots(9)$$

$$F_{zrl}=Mv\{(g\cdot Lf+Gx\cdot H)/(2L)-Gy\cdot H\cdot Rr/Tr\} \quad \cdots\cdots (10)$$

$$F_{zrr}=Mv\{(g\cdot Lf+Gx\cdot H)/(2L)+Gy\cdot H\cdot Rr/Tr\} \quad \cdots\cdots (11)$$

【００６５】ステップ２５０に於いては下記の式１２に従って車輌の目標前後力F_{xt}及び目標横力F_{yt}の合力として車輌の目標発生力F_{xyt}が演算されると共に、下記の式１３が成立するので、車輌に目標ヨーモーメントMtを与えることなく車輌の目標発生力F_{xyt}を達成する各＊車輪の目標発生力、即ち各車輪の第一の目標発生力F_{xyt0i}（i＝fl、fr、rl、rr）が下記の式１４～１７に従って演算される。

【００６６】

$$F_{xyt}=(F_{xt}^2+F_{yt}^2)^{1/2} \quad \cdots\cdots (12)$$

$$F_{zfl}+F_{zfr}+F_{zrl}+F_{zrr}=Mv\cdot g \quad \cdots\cdots (13)$$

$$F_{xyt0fl}=F_{xyt}\cdot F_{zfl}/(Mv\cdot g) \quad \cdots\cdots (14)$$

$$F_{xyt0fr}=F_{xyt}\cdot F_{zfr}/(Mv\cdot g) \quad \cdots\cdots (15)$$

$$F_{xyt0rl}=F_{xyt}\cdot F_{zrl}/(Mv\cdot g) \quad \cdots\cdots (16)$$

$$F_{xyt0rr}=F_{xyt}\cdot F_{zrr}/(Mv\cdot g) \quad \cdots\cdots (17)$$

【００６７】この場合、車輌の目標発生力F_{xyt}を達成する各車輪の目標発生力F_{xyt0i}の車輌前後方向の成分及び車輌横方向の成分をそれぞれF_{xt0i}及びF_{yt0i}（i＝fl、fr、rl、rr）とし、左右前輪及び左右後輪の車輌横方向の成分の合計をそれぞれF_{yt0f}及びF_{yt0r}とし、左前後輪及び右前後輪の車輌前後方向の成分の合計をそれぞれF_{xt0L}及びF_{xt0R}とすると、これらの合計の力はそれぞれ下記の式１８～２１により表される。

【００６８】

$$F_{yt0f}=F_{yt0fl}+F_{yt0fr} \quad \cdots\cdots (18)$$

$$F_{yt0r}=F_{yt0rl}+F_{yt0rr} \quad \cdots\cdots (19)$$

$$F_{xt0L}=F_{xt0fl}+F_{xt0rl} \quad \cdots\cdots (20)$$

$$F_{xt0R}=F_{xt0fr}+F_{xt0rr} \quad \cdots\cdots (21)$$

【００６９】また左右前輪の接地荷重をF_{zf}とし、左右※後輪の接地荷重をF_{zr}とし、左前後輪の接地荷重をF_{zL}とし、右前後輪の接地荷重をF_{zR}として、合計の力F_{yt0f}、F_{yt0r}、F_{xt0L}、F_{xt0R}はそれぞれ下記の式２２～２５により表される。

$$F_{yt0f}=F_{zf}\cdot G_{yt}/g \quad \cdots\cdots (22)$$

$$F_{yt0r}=F_{zr}\cdot G_{yt}/g \quad \cdots\cdots (23)$$

$$F_{xt0L}=F_{zL}\cdot G_{xt}/g \quad \cdots\cdots (24)$$

$$F_{xt0R}=F_{zR}\cdot G_{xt}/g \quad \cdots\cdots (25)$$

【００７０】尚上記各式に於ける左右前輪の接地荷重F_{zf}、左右後輪の接地荷重F_{zr}、左前後輪の接地荷重F_{zl}、右前後輪の接地荷重F_{zr}はそれぞれ下記の式２６～２９により表される。

【００７１】

$$\begin{aligned}F_{zf}&=F_{zfl}+F_{zfr}\\&=Mv\cdot g\cdot Lr/L-Mv\cdot Gx\cdot H/L \quad \cdots\cdots (26)\end{aligned}$$

$$\begin{aligned}F_{zr}&=F_{zrl}+F_{zrr}\\&=Mv\cdot g\cdot Lf/L+Mv\cdot Gx\cdot H/L \quad \cdots\cdots (27)\end{aligned}$$

$$\begin{aligned}F_{zL}&=F_{zfl}+F_{zrl}\\&=Mv\cdot g/2-Mv\cdot Gy\cdot H/Tr \quad \cdots\cdots (28)\end{aligned}$$

$$\begin{aligned}F_{zR}&=F_{zfr}+F_{zrr}\\&=Mv\cdot g/2+Mv\cdot Gy\cdot H/Tr \quad \cdots\cdots (29)\end{aligned}$$

【００７２】更に車輌の目標ヨーモーメントMtは下記の式３０にて演算され、この式３０に上記式２２～２５及び式２６～２９を代入すると、式３０の右辺は０にな★る。従って上記式１４～１７式により求められる各車輪の第一の目標発生力F_{xyt0i}は車輌にヨーモーメントを与えないことが解る。

$$\begin{aligned}Mt&=Iy\cdot\gamma td\\&=Lf\cdot F_{yt0f}-Lr\cdot F_{yt0r}+(F_{xt0L}-F_{xt0R})\cdot Tr/2 \quad \cdots\cdots (30)\end{aligned}$$

【００７３】ステップ３００に於いては後述の図３に示されたルーチンに従って各車輪の目標発生力F_{xyti}を車輌の目標発生力F_{xyt}の方向に厳密に一致させる制御則により、車輌の目標ヨーモーメントMtのみを達成するための各車輪の目標発生力の補正量、即ち各車輪の第二の目標発生力ΔF_{xyti}（i＝fl、fr、rl、rr）が演算される。

【００７４】ステップ３５０に於いては下記の式２４に従ってステップ２５０に於いて演算された各車輪の第一の目標発生力F_{xyt0i}とステップ３００に於いて演算された各車輪の第二の目標発生力ΔF_{xyti}との和として各車輪の目標発生力F_{xyti}（i＝fl、fr、rl、rr）が演算される。

$$F_{xyti}=F_{xyt0i}+\Delta F_{xyti} \quad \cdots\cdots (31)$$

【００７５】ステップ６００に於いては後述の図４に示されたルーチンに従って各車輪の目標舵角δti、各車輪の車輪座標に於ける目標車輪前後力F_{wxti}、各車輪の目標スリップ率S_{ti}（i＝fl、fr、rl、rr）が演算される。

【００７６】ステップ７００に於いては後述の図５に示されたルーチンに従って各車輪の目標制動圧P_{ti}及びエンジン１０の目標駆動トルクT_{et}が演算され、ステップ８００に於いては各車輪の舵角δiが目標舵角δtiになり、エンジン１０の出力トルクが目標駆動トルクT_{et}になるよう舵角制御装置６２及びエンジン制御装置２６へ指令信号が出力され、また各車輪の制動圧P_iが目標制動圧P_{ti}になるよう制動装置４２が制御されることにより、各車輪の発生力がそれぞれ対応する目標発生力F_{xyti}に制御され、しかる後ステップ５０へ戻る。

【００７７】図３に示された各車輪の第二の目標発生力ΔF_{xyti}演算ルーチンのステップ３１０に於いては、図８に示されている如く、上述のステップ２５０に於いて演算された各車輪の第一の目標発生力F_{xyt0i}により車輌１２に対しその重心９０の周りに与えられる各ヨーモーメントのアーム長さD_i（i＝fl、fr、rl、rr）が下記の式３２～３５に従って演算される。

【００７８】

$$D_{fl}=|F_{yt0fl}\cdot Tr/2+F_{xt0fl}\cdot Lf| \quad \cdots\cdots(32)$$
$$D_{fr}=|-F_{yt0fr}\cdot Tr/2+F_{xt0fr}\cdot Lf| \quad \cdots\cdots(33)$$
$$D_{rl}=|F_{yt0rl}\cdot Tr/2-F_{xt0rl}\cdot Lr| \quad \cdots\cdots(34)$$
$$D_{rr}=|-F_{yt0rr}\cdot Tr/2-F_{xt0rr}\cdot Lr| \quad \cdots\cdots(35)$$

【００７９】尚図８及び後述の図１１に於いて、各車輪の接地点P_{zi}（i＝fl、fr、rl、rr）を中心として示された円は各車輪の接地荷重F_{zi}の大小関係、従って摩擦円の大小関係を示している。

【００８０】ステップ３２０に於いては車輌の目標ヨーモーメントM_tのみを達成するための左右前輪の第二の目標発生力ΔF_{xytfl}、ΔF_{xytfr}の合計及び左右後輪の第二の目標発生力ΔF_{xytrl}、ΔF_{xytrr}の合計をΔF_{xyt}とし、合計の力ΔF_{xyt}が左右の車輪の接地荷重に応じて配分されるとすると、下記の式３６が成立するので、式３６の右辺第三式に於ける合計の力ΔF_{xyt}の係数K_mが下記の式３７に従って演算される。

【００８１】

$$\begin{aligned}M_t&=I_y\cdot\gamma_{td}\\&=\{(F_{zfl}\cdot D_{fl}+F_{zfr}\cdot D_{fr})/(F_{zfl}+F_{zfr})\}\cdot\Delta F_{xyt}\\&\quad+\{(F_{zrl}\cdot D_{rl}+F_{zrr}\cdot D_{rr})/(F_{zrl}+F_{zrr})\}\cdot\Delta F_{xyt}\\&=\{(F_{zfl}\cdot D_{fl}+F_{zfr}\cdot D_{fr})/(F_{zfl}+F_{zfr})\\&\quad+(F_{zrl}\cdot D_{rl}+F_{zrr}\cdot D_{rr})/(F_{zrl}+F_{zrr})\}\cdot\Delta F_{xyt}\end{aligned} \quad \cdots\cdots(36)$$

$$\begin{aligned}K_m=&(F_{zfl}\cdot D_{fl}+F_{zfr}\cdot D_{fr})/(F_{zfl}+F_{zfr})\\&+(F_{zrl}\cdot D_{rl}+F_{zrr}\cdot D_{rr})/(F_{zrl}+F_{zrr})\end{aligned} \quad \cdots\cdots(37)$$

【００８２】ステップ３３０に於いては下記の式３８～４１に従って車輌の目標ヨーモーメントM_tのみを達成するための各車輪の第二の目標発生力ΔF_{xyti}（i＝fl、fr、rl、rr）が演算される。

【００８３】

$$\begin{aligned}\Delta F_{xytfl}&=\{F_{zfl}/(F_{zfl}+F_{zfr})\}\cdot\Delta F_{xyt}\\&=\{F_{zfl}/(F_{zfl}+F_{zfr})\}\cdot I_y\cdot\gamma_{td}/K_m\end{aligned} \quad \cdots\cdots(38)$$
$$\begin{aligned}\Delta F_{xytfr}&=\{F_{zfr}/(F_{zfl}+F_{zfr})\}\cdot\Delta F_{xyt}\\&=\{F_{zfr}/(F_{zfl}+F_{zfr})\}\cdot I_y\cdot\gamma_{td}/K_m\end{aligned} \quad \cdots\cdots(39)$$
$$\begin{aligned}\Delta F_{xytrl}&=-\{F_{zrl}/(F_{zrl}+F_{zrr})\}\cdot\Delta F_{xyt}\\&=-\{F_{zrl}/(F_{zrl}+F_{zrr})\}\cdot I_y\cdot\gamma_{td}/K_m\end{aligned} \quad \cdots\cdots(40)$$
$$\begin{aligned}\Delta F_{xytrr}&=-\{F_{zrr}/(F_{zrl}+F_{zrr})\}\cdot\Delta F_{xyt}\\&=-\{F_{zrr}/(F_{zrl}+F_{zrr})\}\cdot I_y\cdot\gamma_{td}/K_m\end{aligned} \quad \cdots\cdots(41)$$

【００８４】図４に示された各車輪の目標舵角δti、各車輪の目標車輪前後力F_{wxti}、各車輪の目標スリップ率S_{ti}演算ルーチンのステップ６１０に於いては、下記の式４２～４５に従って各車輪の接地点の目標進行方向角α_{wti}（i＝fl、fr、rl、rr）が演算される。尚左前輪について図９に示されている如く、接地点の目標進行方向角α_{wti}は各車輪の接地点P_{zi}の目標進行方向が車輌の前後方向に対しなす角度である。

【００８５】

$$\alpha_{wtfl}=(\beta t\cdot Vx+Lf\cdot\gamma t)/(Vx-Tr\cdot\gamma t/2) \quad \cdots\cdots(42)$$
$$\alpha_{wtfr}=(\beta t\cdot Vx+Lf\cdot\gamma t)/(Vx+Tr\cdot\gamma t/2) \quad \cdots\cdots(43)$$
$$\alpha_{wtrl}=(\beta t\cdot Vx-Lr\cdot\gamma t)/(Vx-Tr\cdot\gamma t/2) \quad \cdots\cdots(44)$$

$$\alpha wtrr = (\beta t \cdot Vx - Lr \cdot \gamma t) / (Vx + Tr \cdot \gamma t / 2) \quad \cdots\cdots (45)$$

【００８６】ステップ６２０に於いては上述の式８～１１にそれぞれ対応する下記の式４６～４９に従って車輌の目標前後加速度Gxt及び目標横加速度Gytに基づき各車輪の目標接地荷重Fzti（i＝fl、fr、rl、rr）が演算される。

【００８７】

$$Fztfl = Mv\{(g \cdot Lr - Gxt \cdot H) / (2L) - Gyt \cdot H \cdot Rf / Tr\} \quad \cdots\cdots (46)$$

$$Fztfr = Mv\{(g \cdot Lr - Gxt \cdot H) / (2L) + Gyt \cdot H \cdot Rf / Tr\} \quad \cdots\cdots (47)$$

$$Fztrl = Mv\{(g \cdot Lf + Gxt \cdot H) / (2L) - Gyt \cdot H \cdot Rr / Tr\} \quad \cdots\cdots (48)$$

$$Fztrr = Mv\{(g \cdot Lf + Gxt \cdot H) / (2L) + Gyt \cdot H \cdot Rr / Tr\} \quad \cdots\cdots (49)$$

【００８８】ステップ６３０に於いては左前輪について図１０に示されている如く、各車輪の目標発生力Fxytiが各車輪の車輪座標に於ける目標前後力及び目標横力に分解された値、即ち目標車輪前後力Fwxti及び目標車輪横力Fwyti（i＝fl、fr、rl、rr）がそれぞれ下記の式５０及び５１に従って演算される。

【００８９】

$$Fwxti = Fxyti \cdot \cos(\pi/2 - \delta ti) = Fxyti \cdot \sin\delta ti \quad \cdots\cdots (50)$$

$$Fwyti = Fxyti \cdot \sin(\pi/2 - \delta ti) = Fxyti \cdot \cos\delta ti \quad \cdots\cdots (51)$$

【００９０】ステップ６４０に於いては下記の式５２に従って各車輪の目標スリップ角βwti（i＝fl、fr、rl、rr）が各車輪の接地点目標進行方向角αwtiと目標舵角δtiとの和として演算される。

$$Bwti = \alpha wti + \delta ti \quad \cdots\cdots (52)$$

【００９１】ステップ６５０に於いては各車輪の目標車輪前後力Fwxti、各車輪の目標スリップ角βwti及び各車輪の目標接地荷重Fztiに基づき図には示されていないタイヤ発生力マップ又はタイヤモデルに基づく演算式により各車輪の横力発生予測値Fwyai及び目標スリップ率Sti（i＝fl、fr、rl、rr）が演算される。

【００９２】ステップ６６０に於いては下記の式５３に従って各車輪について目標車輪横力Fwytiと横力発生予測値Fwyaiとの偏差ΔFwyi（i＝fl、fr、rl、rr）が演算される。

$$\Delta Fwyi = Fwyti - Fwyai \quad \cdots\cdots (53)$$

【００９３】ステップ６７０～６９０は例えば左前輪、右前輪、左後輪、右後輪の順に各車輪について実行され、特にステップ６７０に於いては車輪横力の偏差ΔFwyiの絶対値が基準値ΔFwyo（正の定数）未満であるか否かの判別、即ち目標舵角δtiの修正が不要であるか否かの判別が行われ、否定判別が行われたときにはステップ６８０へ進み、肯定判別が行われたときにはステップ６７５に於いて目標舵角δtiが前回値に設定された後ステップ７００へ進む。

【００９４】ステップ６８０に於いてはKsを正の定数として下記の式５４に従って各車輪の目標舵角の修正量Δδti（i＝fl、fr、rl、rr）が演算され、ステップ６９０に於いては各車輪の目標舵角δti（i＝fl、fr、rl、rr）がδti＋Δδtiに修正され、しかる後ステップ６３０へ戻る。

$$\Delta\delta ti = Ks \cdot \Delta Fwyi \quad \cdots\cdots (54)$$

【００９５】図５に示された各車輪の目標制動圧Pti及びエンジンの目標駆動トルクTet演算ルーチンのステップ７１０に於いては、下記の式５５～５８に従って各車輪の接地点の目標前後速度Vwxti（i＝fl、fr、rl、rr）が演算されると共に、下記の式５９に従って各車輪の転動方向の目標移動速度Vtwti（i＝fl、fr、rl、rr）が演算される。

【００９６】

$$Vwxtfl = Vx + Tr \cdot \gamma / 2 \quad \cdots\cdots (55)$$

$$Vwxtfr = Vx - Tr \cdot \gamma / 2 \quad \cdots\cdots (56)$$

$$Vwxtrl = Vwxtfl \quad \cdots\cdots (57)$$

$$Vwxtrr = Vwxtfr \quad \cdots\cdots (58)$$

$$Vtwti = Vwxti(\cos\delta ti - \tan\beta wti \cdot \sin\delta ti) \quad \cdots\cdots (59)$$

【００９７】ステップ７２０に於いては目標スリップ率Sti及び転動方向の目標移動速度Vrwtiに基づき下記の式６０に従って各車輪の目標車輪速度Vrwti（i＝fl、fr、rl、rr）が演算される。

$$Vrwti = (1 - Sti) Vrwti \quad \cdots\cdots (60)$$

【００９８】ステップ７３０に於いては例えば目標車輪速度Vrwtiの時間微分値として各車輪の目標車輪加速度Vrwtdi（i＝fl、fr、rl、rr）が演算されると共に、車輪の有効半径をRwとし、車輪の回転慣性モーメントをIwとして下記の式６１に従って各車輪の目標回転トルクTwti（i＝fl、fr、rl、rr）が演算される。

$$Twti = Fwxti \cdot Rw + Iw \cdot Vrwtdi \quad \cdots\cdots (61)$$

【００９９】ステップ７４０に於いては全ての車輪の目標回転トルクTwtiが負の値であるか否かの判別、即ち

全ての車輪について制動が必要な状況であるか否かの判別が行われ、肯定判別が行われたときにはステップ７７０へ進み、否定判別が行われたときにはステップ７５０へ進む。

【０１００】ステップ７５０に於いてはシフトポジションＰsに基づき駆動系のギヤ比Ｒdが求められると共に、駆動系による各車輪に対するエンジン１０の駆動トルクの配分率をＸｉ（ｉ＝fl、fr、rl、rr）（０＜Ｘｉ＜０．５、ΣＸｉ＝１）とし、四輪の目標回転トルクＴwtiのうちの最大値をＴwtmaxとし、目標回転トルクが最大値Ｔwtmaxである車輪（最大駆動トルク車輪）の駆動トルク配分率をＸmaxとして、エンジン１０の目標駆動トルクＴetが下記の式６２に従って演算される。

Ｔet＝Ｔwtmax・Ｒd／Ｘmax ……（６２）

【０１０１】ステップ７６０に於いては最大駆動トルク車輪の目標制動圧Ｐtiが０に設定されると共に、制動圧と制動トルクとの変換係数をＫｐとして最大駆動トルク車輪以外の各車輪の目標制動圧Ｐtiが下記の式６３に従って演算され、しかる後ステップ８００へ進む。

Ｐti＝（Ｔwtmax・Ｘｉ／Ｘmax－Ｔwti）／Ｋｐ ……（６３）

【０１０２】ステップ７７０に於いてはエンジン１０の目標駆動トルクＴetが０に設定され、ステップ７８０に於いては各車輪の目標制動圧Ｐtiが下記の式６４に従って演算され、しかる後ステップ８００へ進む。

Ｐti＝－Ｔwti／Ｋｐ ……（６４）

【０１０３】かくして図示の第一の実施形態によれば、ステップ１００に於いて車速Ｖx等に基づき車輌の目標運動状態量として車輌の目標ヨーレートγt、車輌の目標横加速度Ｇyt、車輌の目標前後加速度Ｇxtが演算され、ステップ１５０に於いて車輌の目標内部状態量として車輌の目標前後加速度Ｇxtに対応する車輌の目標前後力Ｆxt、目標横加速度Ｇytに対応する車輌の目標横力Ｆyt、目標ヨーレートγtに対応する車輌の目標ヨーモーメントＭt、車輌の目標スリップ角βtが演算される。

【０１０４】またステップ２００に於いて各車輪の垂直荷重Ｆziが演算され、ステップ２５０に於いて車輌の目標前後力Ｆxt及び目標横力Ｆytの合力として車輌の目標発生力Ｆxytが演算されると共に、車輌にヨーモーメントを与えることなく車輌の目標発生力Ｆxytを達成する各車輪の第一の目標発生力Ｆxyt0iが演算され、ステップ３００に於いて各車輪の目標発生力Ｆxytiを車輌の目標発生力Ｆxytの方向に厳密に一致させる制御則により、車輌の目標ヨーモーメントＭtのみを達成するための各車輪の第二の目標発生力ΔＦxytiが演算され、ステップ３５０に於いて第一の目標発生力Ｆxyt0iと第二の目標発生力ΔＦxytiとの和として各車輪の目標発生力Ｆxytiが演算される。

【０１０５】従って図示の第一の実施形態によれば、車輌の目標前後力Ｆxt、目標横力Ｆyt、目標ヨーモーメントＭtを確実に達成するよう、換言すれば車輌の目標ヨーレートγt、車輌の目標横加速度Ｇyt、車輌の目標前後加速度Ｇxtを確実に達成するよう、各車輪の目標発生力Ｆxytiを演算することができ、これにより運転者による操舵制御操作量（操舵角θ）、駆動力制御操作量（スロットル開度Ｔa）、制動制御操作量（ブレーキペダル踏力Ｆb）に応じた所望の運動状態にて車輌を安定的に走行させることができる。

【０１０６】また全ての車輪の目標発生力Ｆxytiの方向を車輌の目標発生力Ｆxytの方向に完全に整合させることができるので、各車輪が発生する力の一部が車輌１２の車体に内部応力として無駄に作用することを確実に防止することができ、これにより各車輪が発生する力を最も効率的に利用して車輌を安定的に走行させることができる。

【０１０７】また図示の第一の実施形態によれば、ステップ６００に於いて各車輪の目標発生力Ｆxytiを達成する各車輪の目標舵角δti、各車輪の車輪座標に於ける目標車輪前後力Ｆwxti、各車輪の目標スリップ率Ｓtiが演算され、ステップ７００に於いて各車輪の目標制動圧Ｐti及びエンジンの目標駆動トルクＴetが演算され、ステップ８００に於いて各車輪の舵角δiが目標舵角δtiになり、エンジン１０の出力トルクが目標駆動トルクＴetになるよう舵角制御装置６２及びエンジン制御装置２６へ指令信号が出力され、また各車輪の制動圧Ｐiが目標制動圧Ｐtiになるよう制動装置４２が制御されることにより、各車輪の発生力がそれぞれ対応する目標発生力Ｆxytiに制御される。

【０１０８】従って図示の第一の実施形態によれば、各車輪の発生力がそれぞれ対応する目標発生力Ｆxytiになるよう各車輪の舵角及び制駆動力が制御されるので、車輪の制駆動力しか制御されない従来の走行制御装置の場合に比して、各車輪の発生力の大きさ及び方向の制御範囲を拡大し、車輪（タイヤ）の性能を有効に利用することができ、これにより各車輪の発生力を対応する目標発生力Ｆxytiに確実に制御することができる。

【０１０９】また図示の第一の実施形態によれば、上述の如く各車輪の発生力がそれぞれ対応する目標発生力Ｆxytiになるよう各車輪の舵角及び制駆動力がフィードフォワード制御されることにより、車輌の前後加速度Ｇx、横加速度Ｇy、ヨーレートγがそれぞれ車輌の目標前後加速度Ｇxt、目標横加速度Ｇyt、目標ヨーレートγtに制御されるので、車輌の目標挙動指標値と車輌の実際の挙動指標値との偏差に基づき該偏差が小さくなるようフィードバック制御により各車輪の制駆動力が個別に制御される従来の一般的な走行制御装置の場合に比して、応答遅れやハンチング等の問題を生じることなく車輌の走行運動を確実に且つ効果的に運転者による運転操作に応じて制御することができる。

【０１１０】特に図示の第一の実施形態によれば、ステップ６００に於いて各車輪の発生力を目標発生力F_{xyti}とするための各車輪の目標舵角δ_{ti}、各車輪の車輪座標に於ける目標車輪前後力F_{wxti}、各車輪の目標スリップ率S_{ti}が演算され、ステップ７１０及び７２０に於いて目標スリップ率S_{ti}に基づき各車輪の目標車輪速度V_{rwti}が演算され、ステップ７３０に於いて各車輪の目標車輪加速度V_{rwdti}が演算されると共に、各車輪の目標車輪前後力F_{wxti}及び目標車輪加速度V_{rwdti}に基づき各車輪の目標回転トルクT_{wti}が演算されるので、各車輪の目標スリップ率S_{ti}に基づいて演算される目標車輪加速度V_{rwdti}が考慮されない場合に比して、各車輪の目標回転トルクT_{wti}を正確に演算することができる。

【０１１１】また図示の第一の実施形態によれば、各車輪の目標回転トルクT_{wti}のうち駆動側の最大値T_{wtmax}に基づき駆動源としてのエンジン１０の目標駆動トルクT_{et}が演算され、目標回転トルクが最大である車輪以外の他の車輪について最大値T_{wtmax}及び他の車輪の目標回転トルクT_{wti}に基づき目標制動圧P_{ti}が演算されるので、エンジン１０をその駆動トルクが目標駆動トルクT_{et}になるよう制御すると共に、上記他の車輪の制動圧P_iを目標制動圧P_{ti}に制御することにより、容易に且つ確実に各車輪の発生力を目標発生力F_{xyti}に制御することができる。

【０１１２】また図示の第一の実施形態によれば、ステップ６６０に於いて目標車輪横力F_{wyti}と横力発生予測値F_{wyati}との偏差ΔF_{wyti}が演算され、ステップ６７０～６９０に於いて目標車輪横力F_{wyti}と横力発生予測値F_{wyati}との偏差ΔF_{wyti}の大きさが基準値未満であるときには、当該車輪の目標舵角δ_{ti}が前回の目標舵角に設定され、目標車輪横力F_{wyti}と横力発生予測値F_{wyati}との偏差ΔF_{wyti}の大きさが基準値以上であるときには、偏差ΔF_{wyti}に基づき目標舵角修正量$\Delta\delta_{ti}$が演算されると共に、前回の目標舵角が目標舵角修正量$\Delta\delta_{ti}$にて修正された値が当該車輪の目標舵角δ_{ti}に設定されるので、各車輪の目標舵角δ_{ti}を発散させることなく確実に演算することができる。

【０１１３】<u>第二の実施形態</u>

図６は本発明による四輪車輌の走行制御装置の第二の実施形態に於ける各車輪の舵角制御及び制駆動力制御のメインルーチンを示すフローチャートである。尚図６に於いて、図２に示されたステップに対応するステップには図２に於いて付されたステップ番号と同一のステップ番号が付されている。

【０１１４】この実施形態のステップ５０～２５０及びステップ６００～８００は上述の第一の実施形態と同様に実行され、ステップ２５０の次に実行されるステップ４００に於いては図７に示されたルーチンに従って車輌の目標発生力F_{xyt}を厳密に各車輪の接地荷重に比例して配分する制御則により、車輌の目標ヨーモーメントM_tのみを達成するための各車輪の発生力（第二の目標発生力）の合力F_m、各車輪の目標基本発生力F_{bxyti}（i＝fl、fr、rl、rr）、各車輪の目標基本発生力に対する補正係数K_rが演算される。

【０１１５】ステップ５５０に於いては各車輪の目標発生力F_{xyti}が下記の式６５に従って補正係数K_rと目標基本発生力F_{bxyti}との積として演算され、しかる後ステップ６００へ進む。

$$F_{xyti}=K_r\cdot F_{bxyti} \quad \cdots\cdots (65)$$

【０１１６】図７に示された各車輪の第二の目標発生力の合力F_m、車輌の目標基本発生力F_{bxyti}、補正係数K_r演算ルーチンのステップ４１０に於いては、車輌の前後加速度G_xと車輌の横加速度G_yとの積が０であるか否かの判別、即ち車輌の前後加速度G_x若しくは車輌の横加速度G_yが０であるか否かの判別が行われ、否定判別が行われたときにはステップ４５０へ進み、肯定判別が行われたときにはステップ４２０へ進む。

【０１１７】ステップ４２０に於いては車輪発生力のベクトル回転により車輌の目標ヨーモーメントM_tを達成する車輪が左右前輪及び左右後輪に特定されるよう、車輪発生力がベクトル回転される車輪を示すｊがfl、fr、rl、rrに設定されると共に、ｊがfr及びrlである場合について図１１に示されている如く各車輪の接地点P_{zi}と車輌の重心９０とを結ぶ線分に対し各車輪の目標発生力F_{xyt0i}のベクトルがなす角度θ_j（ｊ＝fl、fr、rl、rr）が下記の式６６～６９に従って演算される。

【０１１８】

$$\theta_{fl}=\tan^{-1}|F_{xt0fl}/F_{yt0fl}|-\tan^{-1}|2L_f/T_r| \quad \cdots\cdots (66)$$

$$\theta_{fr}=\tan^{-1}|F_{xt0fr}/F_{yt0fr}|-\tan^{-1}|2L_f/T_r| \quad \cdots\cdots (67)$$

$$\theta_{rl}=\tan^{-1}|F_{xt0rl}/F_{yt0rl}|-\tan^{-1}|2L_r/T_r| \quad \cdots\cdots (68)$$

$$\theta_{rr}=\tan^{-1}|F_{xt0rr}/F_{yt0rr}|-\tan^{-1}|2L_r/T_r| \quad \cdots\cdots (69)$$

【０１１９】ステップ４３０に於いては下記の式７０に従って車輌の目標ヨーモーメントM_tのみを発生させるための合力、即ちステップ４２０に於いて特定された四輪の第二の目標発生力の合力F_mが演算される。

【０１２０】

【数１】

$$F_m=I_y\cdot\gamma_t/\sum_{i=j}\cos\theta_i \quad \cdots\cdots (70)$$

【０１２１】ステップ４４０に於いては下記の式７１～７４に従って各車輪の目標基本発生力F_{bxyti}（ｉ＝fl、fr、rl、rr）が演算される。

$$F_{bxytfl}=(F_{xyt0fl}^2+F_m^2)^{1/2} \quad \cdots\cdots (71)$$

$$F_{bxytfr} = (F_{xyt0fr}^2 + F_m^2)^{1/2} \quad \cdots\cdots (72)$$
$$F_{bxytrl} = (F_{xyt0rl}^2 + F_m^2)^{1/2} \quad \cdots\cdots (73)$$
$$F_{bxytrr} = (F_{xyt0rr}^2 + F_m^2)^{1/2} \quad \cdots\cdots (74)$$

【０１２２】ステップ４５０に於いては車輌の前後加速度G_xと車輌の横加速度G_yとの積が正の値であるか否かの判別が行われ、否定判別が行われたときはステップ４９０へ進み、肯定判別が行われたときにはステップ４６０へ進む。尚ステップ４１０及び４５０の積に使用される車輌の前後加速度及び横加速度は車速V_x等に基づき推定される値であってもよく、また目標前後加速度G_{xt}及び目標横加速度G_{yt}であってもよい。

【０１２３】ステップ４６０に於いては車輪発生力のベクトル回転により車輌の目標ヨーモーメントM_tを達成する車輪が左前輪及び右後輪に特定されるよう、車輪発生力がベクトル回転される車輪を示すｊがfl及びrrに設定され、車輪発生力がベクトル回転されない車輪を示すｋがfr及びrlに設定されると共に、左前輪及び右後輪の接地点P_{zfl}、P_{zrr}と車輌の重心９０とを結ぶ線分に対し左前輪及び右後輪の目標発生力F_{xyt0fl}及びF_{xyt0rr}のベクトルがなす角度θ_j（ｊ＝fl、rr）が上記式６６及び６９に従って演算される。

【０１２４】ステップ４７０に於いては上記式７０に従って車輌の目標ヨーモーメントM_tを発生させるための合力F_m、即ち左前輪及び右後輪の第二の目標発生力の合力が演算され、ステップ４８０に於いては下記の式７５～７８に従って各車輪の目標基本発生力F_{bxyti}が演算される。

【０１２５】

$$F_{bxytfl} = (F_{xyt0fl}^2 + F_m^2)^{1/2} \quad \cdots\cdots (75)$$
$$F_{bxytfr} = F_{xyt0fr} \quad \cdots\cdots (76)$$
$$F_{bxytrl} = F_{xyt0rl} \quad \cdots\cdots (77)$$
$$F_{bxytrr} = (F_{xyt0rr}^2 + F_m^2)^{1/2} \quad \cdots\cdots (78)$$

＊【０１２６】ステップ４９０に於いては車輪の発生力のベクトル回転により車輌の目標ヨーモーメントM_tを達成する車輪が右前輪及び左後輪に特定されるよう、ｊがfr及びrlに設定され、ｋがfl及びrrに設定されると共に、図１０に示されている如く右前輪及び左後輪の接地点P_{zfr}、P_{zrl}と車輌の重心９０とを結ぶ線分に対し右前輪及び左後輪の目標発生力F_{xyt0fr}及びF_{xyt0rl}のベクトルがなす角度θ_j（ｊ＝fr、rl）が上記式６７及び６８に従って演算される。

【０１２７】ステップ５００に於いては上記式７０に従って車輌の目標ヨーモーメントM_tを発生させるための合力F_m、即ち右前輪及び左後輪の第二の目標発生力の合力が演算され、ステップ５１０に於いては下記の式７９～８２に従って各車輪の目標基本発生力F_{bxyti}が演算される。

【０１２８】

$$F_{bxytfl} = F_{xyt0fl} \quad \cdots\cdots (79)$$
$$F_{bxytfr} = (F_{xyt0fr}^2 + F_m^2)^{1/2} \quad \cdots\cdots (80)$$
$$F_{bxytrl} = (F_{xyt0rl}^2 + F_m^2)^{1/2} \quad \cdots\cdots (81)$$
$$F_{bxytrr} = F_{xyt0rr} \quad \cdots\cdots (82)$$

【０１２９】尚上述のステップ４３０、４７０、５００に於いて、ステップ４２０に於いて特定された車輪の第一の目標発生力F_{xyt0j}の最小値を$F_{xyt0min}$として$|F_m| > |F_{xyt0min}|$であるときには、第一の目標発生力の最小値$F_{xyt0min}$をベクトル回転させても合力F_mを達成することができないので、合力F_mは$F_{xyt0min}$に設定される。

【０１３０】ステップ５２０に於いては下記の式８３を満たす値として補正係数K_rが演算される。

【０１３１】

【数２】＊

$$K_r\left\{\sum_{i=j}\sqrt{F_{xyti}^2-\left(\frac{F_m}{K_r}\right)^2}+\sum_{i=k}F_{xyti}\right\}=F_{xyt} \quad \cdots\cdots (83)$$

【０１３２】かくして図示の第二の実施形態によれば、ステップ４００に於いて車輌の目標発生力F_{xyt}を厳密に各車輪の接地荷重に比例して配分する制御則により、車輌の目標ヨーモーメントM_tのみを達成するための第二の目標発生力の合力F_m、各車輪の目標基本発生力F_{bxyti}、各車輪の目標基本発生力に対する補正係数K_rが演算され、ステップ５５０に於いて各車輪の目標発生力F_{xyti}が補正係数K_rと目標基本発生力F_{bxyti}との積として演算される。

【０１３３】従って各車輪の目標発生力F_{xyti}は各車輪の接地荷重に厳密に比例するよう、換言すれば各車輪の摩擦円の大きさに厳密に比例するよう演算されるので、各車輪が発生し得る力に対する限界マージンを最大にすることができ、これにより各車輪の力発生能力を最大限に発揮させることができる。

【０１３４】特に図示の第二の実施形態によれば、ステップ４１０、４２０、４５０、４６０、４９０に於いて車輌の前後加速度G_xと車輌の横加速度G_yとの積$G_x \cdot G_y$の符号に基づき、換言すれば車輌の目標発生力F_{xyt}の方向に基づき、車輪発生力のベクトル回転により車輌の目標ヨーモーメントM_tを効率的に達成する二つの車輪が特定され、ステップ４３０、４７０、５００に於いて特定された車輌について目標ヨーモーメントM_tのみを発生させるための第二の目標発生力の合力F_mが演算され、ステップ４４０、４８０、５１０に於いて各車輪の第一の目標発生力F_{xyt0i}及び第二の目標発生力の合力F_mに基づき各車輪の目標基本発生力F_{bxyti}が演算され、ステップ５５０に於いて目標基本発生力F_{bxyti}の大きさが補正係数K_rによって補正されることにより各車輪の目標発生力F_{xyti}が演算される。

【０１３５】車輌の目標発生力F_{xyt}の方向に拘わらず一つの車輪又は全ての車輪について第二の目標発生力の合力F_mが演算される場合には、全ての車輪の目標発生力F_{xyti}の方向が車輌の目標発生力F_{xyt}の方向とは異なる方向になるのに対し、図示の第二の実施形態によれば、特定された車輪以外の二つの車輪の目標発生力F_{xyti}は必ず車輌の目標発生力F_{xyt}の方向と同一になるので、一つの車輪又は全ての車輪について第二の目標発生力の合力F_mが演算される場合に比して、車輌の車体に内部応力として無駄に作用する力を低減することができる。

【０１３６】尚図示の第二の実施形態によれば、ステップ５０～２５０及びステップ６００～８００は上述の第一の実施形態の場合と同様に実行されるので、これらのステップにより得られる上述の第一の実施形態の作用効果と同一の作用効果を得ることができる。

【０１３７】以上に於ては本発明を特定の実施形態について詳細に説明したが、本発明は上述の実施形態に限定されるものではなく、本発明の範囲内にて他の種々の実施形態が可能であることは当業者にとって明らかであろう。

【０１３８】例えば図示の実施形態に於ては、車輌１２は駆動源としてのエンジン１０と駆動源の駆動トルクを各車輪へ一定の配分比率にて伝達する駆動系とを有し、制駆動力制御手段はエンジン１０の駆動トルクを制御することにより全ての車輪の駆動力を総括的に制御する駆動力制御手段（エンジン制御装置２６）と、各車輪の制動力を個別に制御可能である制動力制御手段（制動装置４２及び電子制御装置５０）とよりなっているが、車輌が例えば所謂ホイールインモータ式の車輌として構＊成されることにより、駆動力制御手段が各車輪の駆動力を個別に制御可能であり、制動力制御手段が各車輪の制動力を個別に制御可能であるよう構成されてもよい。

【０１３９】また図示の第一の実施形態に於いては、各車輪は油圧式のパワーステアリング装置５６、６６のタイロッド５８Ｌ、５８Ｌ、６８Ｌ、６８Ｒの有効長さがアクチュエータ６０Ｌ、６０Ｌ、７０Ｌ、７０Ｒによって可変制御されることにより操舵されるようになっているが、各車輪は各々個別に設けられた操舵装置により操舵されるよう構成されてもよい。

【０１４０】また図示の第一の実施形態に於いては、車輌の目標ヨーモーメントM_tのみを達成するための左右前輪の第二の目標発生力ΔF_{xytfl}、ΔF_{xytfr}の合計及び左右後輪の第二の目標発生力ΔF_{xytrl}、ΔF_{xytrr}の合計は何れもΔF_{xyt}であるが、車輌の目標ヨーモーメントM_tのみを達成するための左右前輪の第二の目標発生力ΔF_{xytfl}、ΔF_{xytfr}の合計をΔF_{xytf}とし、左右後輪の第二の目標発生力ΔF_{xytrl}、ΔF_{xytrr}の合計をΔF_{xytr}として、ΔF_{xytf}及びΔF_{xytr}が相互に一定の関係を有する限り、ΔF_{xytf}及びΔF_{xytr}は相互に異なる値として演算されてもよい。

【０１４１】例えば前輪の第二の目標発生力の合計ΔF_{xytf}及び後輪の第二の目標発生力の合計ΔF_{xytr}は、ΔF_{xytr}に対するΔF_{xytf}の比が車輌の重心と前輪車軸との間の車輌前後方向の距離をL_fに対する車輌の重心と後輪車軸との間の車輌前後方向の距離L_rの比L_r/L_fになるよう設定されてもよい。

【０１４２】この場合、上記式３６及び式３７はそれぞれ下記の式８４及び式８５の通りになる。

$$
\begin{aligned}
Mt &= I_y \cdot \gamma_{td} \\
&= \{(F_{zfl} \cdot D_{fl} + F_{zfr} \cdot D_{fr}) / (F_{zfl} + F_{zfr})\} \cdot \Delta F_{xytf} \\
&\quad + (F_{zrl} \cdot D_{rl} + F_{zrr} \cdot D_{rr}) / (F_{zrl} + F_{zrr})\} \cdot \Delta F_{xytr} \\
&= \{(F_{zfl} \cdot D_{fl} + F_{zfr} \cdot D_{fr}) / (F_{zfl} + F_{zfr}) \\
&\quad + (F_{zrl} \cdot D_{rl} + F_{zrr} \cdot D_{rr}) / (F_{zrl} + F_{zrr})\} \\
&\quad \cdot (L/L_r)\, \Delta F_{xytf} \quad \cdots\cdots (84)
\end{aligned}
$$

$$
\begin{aligned}
Km &= \{(F_{zfl} \cdot D_{fl} + F_{zfr} \cdot D_{fr}) / (F_{zfl} + F_{zfr}) \\
&\quad + (F_{zrl} \cdot D_{rl} + F_{zrr} \cdot D_{rr}) / (F_{zrl} + F_{zrr})\}\ (L/L_r) \\
&\qquad \cdots\cdots (85)
\end{aligned}
$$

【０１４３】従って車輌の目標ヨーモーメントM_tのみを達成するための各車輪の第二の目標発生力ΔF_{xyti}（i＝fl、fr、rl、rr）は下記の式８６～８９に従って※※演算される。

【０１４４】

$$
\begin{aligned}
\Delta F_{xytfl} &= \{F_{zfl}/(F_{zfl} + F_{zfr})\} \cdot \Delta F_{xytf} \\
&= \{F_{zfl}/(F_{zfl} + F_{zfr})\} \cdot I_y \cdot \gamma_{td}/Km \quad \cdots\cdots (86) \\
\Delta F_{xytfr} &= \{F_{zfr}/(F_{zfl} + F_{zfr})\} \cdot \Delta F_{xytf} \\
&= \{F_{zfr}/(F_{zfl} + F_{zfr})\} \cdot I_y \cdot \gamma_{td}/Km \quad \cdots\cdots (87) \\
\Delta F_{xytrl} &= -\{F_{zrl}/(F_{zrl} + F_{zrr})\} \cdot \Delta F_{xytr} \\
&= -\{F_{zrl}/(F_{zrl} + F_{zrr})\} \cdot I_y \cdot \gamma_{td}\,(L/L_r)/Km \\
&\qquad \cdots\cdots (88) \\
\Delta F_{xytrr} &= -\{F_{zrr}/(F_{zrl} + F_{zrr})\} \cdot \Delta F_{xytr}
\end{aligned}
$$

$$= -\{F_{zrr}/(F_{zrl}+F_{zrr})\}\cdot I_y\cdot\gamma_{td}(L/L_r)/K_m \quad \cdots\cdots (89)$$

【０１４５】
【発明の効果】以上の説明より明らかである如く、本発明の請求項１の構成によれば、運転者による操舵制御操作量、駆動力制御操作量、制動力制御操作量に基づき車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが演算され、各車輪の発生力により車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが達成されるよう各車輪の舵角及び制駆動トルクが制御されるので、各車輪の制駆動力のみが制御される場合に比して各車輪の発生力の大きさ及び方向の制御範囲を拡大し、車輪（タイヤ）の性能を有効に利用することができ、これにより運転者の運転操作に応じて車輌の走行運動を確実に制御することができ、車輌の走行性を向上させることができる。

【０１４６】また請求項１の構成によれば、各車輪の発生力がそれぞれ対応する目標発生力になるよう各車輪の舵角及び制駆動力がフィードフォワード制御されることにより、車輌の前後力、横力、ヨーモーメントがそれぞれ車輌の目標前後力、目標横力、目標ヨーモーメントに制御されるので、車輌の目標挙動指標値と車輌の実際の挙動指標値との偏差に基づき該偏差が小さくなるようフィードバック制御により各車輪の制駆動力が個別に制御される従来の一般的な走行制御装置の場合に比して、車輌の走行運動を確実に且つ効果的に運転者による運転操作に応じて制御することができる。

【０１４７】また請求項２の構成によれば、各車輪の目標発生力の合力の方向が車輌の目標前後力及び車輌の目標横力の合力の方向に沿うと共に、各車輪の目標発生力の合力により車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが達成されるよう各車輪の目標発生力の大きさ及び方向が決定されるので、各車輪の発生力により車輌の目標前後力、車輌の目標横力、車輌の目標ヨーモーメントが効率的に達成されるよう各車輪の目標発生力の大きさ及び方向を決定することができ、従って各車輪が発生する力の一部が車輌の車体に内部応力として無駄に作用することを確実に防止することができ、これにより各車輪が発生する力を最も効率的に利用して車輌を安定的に走行させることができる。

【０１４８】また請求項３の構成によれば、車輌に目標ヨーモーメントを与えることなく車輌の目標前後力及び車輌の目標横力を達成するための各車輪の第一の目標発生力と、目標ヨーモーメントのみを達成するための各車輪の第二の目標発生力との和として各車輪の目標発生力が演算されるので、車輌の目標前後力、目標横力、目標ヨーモーメントを確実に達成するよう各車輪の目標発生力を演算することができる。

【０１４９】また請求項４の構成によれば、各車輪の目標発生力の合力の方向が車輌の目標前後力及び車輌の目標横力の合力の方向に沿う関係を崩すことなく、また各車輪の目標発生力が各車輪の接地荷重に比例する関係を大きく崩すことなく、目標ヨーモーメントを達成する各車輪の第二の目標発生力を確実に演算することができる。

【０１５０】また請求項５の構成によれば、各車輪の目標発生力が完全に各車輪の接地荷重に比例すると共に各車輪の目標発生力の合力の方向が車輌の目標前後力及び車輌の目標横力の合力の方向に沿う関係を崩すことなく、車輌の目標前後力、目標横力、目標ヨーモーメントを達成するための各車輪の目標発生力を確実に演算することができる。

【０１５１】また請求項６の構成によれば、第二の目標発生力を効率的に発生させるに適した車輪として、左右の車輪のうち第二の目標発生力による車輌の重心周りのヨーモーメントのアーム長さが大きい方の車輪が特定されるので、他の車輪が特定される場合に比して第二の目標発生力の大きさが小さくてよく、従って特定された車輪の目標発生力及び特定された車輪以外の車輪の目標発生力の大きさに対する補正量を小さくすることができる。

【０１５２】また特定されない車輪の目標発生力の方向を確実に車輌の目標前後力及び目標横力の合力の方向に整合させることができ、従って一つの車輪又は全ての車輪が特定されることにより、全ての車輪の目標発生力の方向が車輌の目標前後力及び目標横力の合力の方向とは異なる場合に比して、各車輪の目標発生力を容易に演算することができると共に、車輪により発生される力の一部が車輌に内部応力として無駄に作用する程度を確実に低減することができる。

【０１５３】また請求項７の構成によれば、各車輪の目標発生力を達成するための各車輪の目標舵角及び各車輪の目標制駆動トルクを確実に演算することができ、請求項８の構成によれば、各車輪の目標舵角を発散させることなく確実に演算することができる。

【図面の簡単な説明】

【図１】本発明による車輌の走行制御装置の第一の実施形態を示す概略構成図である。

【図２】第一の実施形態に於ける走行制御のメインルーチンを示すフローチャートである。

【図３】図２に示されたフローチャートのステップ３００に於ける各車輪の第二の目標発生力ΔF_{xyti}演算ルーチンを示すフローチャートである。

【図４】図２に示されたフローチャートのステップ６００に於ける各車輪の目標舵角δ_{ti}、目標車輪前後力F_{wxti}、目標スリップ率S_{ti}演算ルーチンを示すフローチャートである。

【図５】図２に示されたフローチャートのステップ７０

０に於ける各車輪の目標制動圧P_{ti}及びエンジンの目標駆動トルクT_{et}演算ルーチンを示すフローチャートである。

【図６】本発明による車輌の走行制御装置の第二の実施形態に於ける走行制御のメインルーチンを示すフローチャートである。

【図７】図６に示されたフローチャートのステップ４００に於ける車輌の目標ヨーモーメントM_t達成力F_m、各車輪の目標基本発生力F_{bxyti}、補正係数K_r演算ルーチンを示すフローチャートである。

【図８】各車輪の第一の目標発生力F_{xyt0i}により車輌に対しその重心の周りに与えられる各ヨーモーメントのアーム長さD_iを示す説明図である。

【図９】左前輪について車輪の接地点の目標進行方向角α_{wtfl}を示す説明図である。

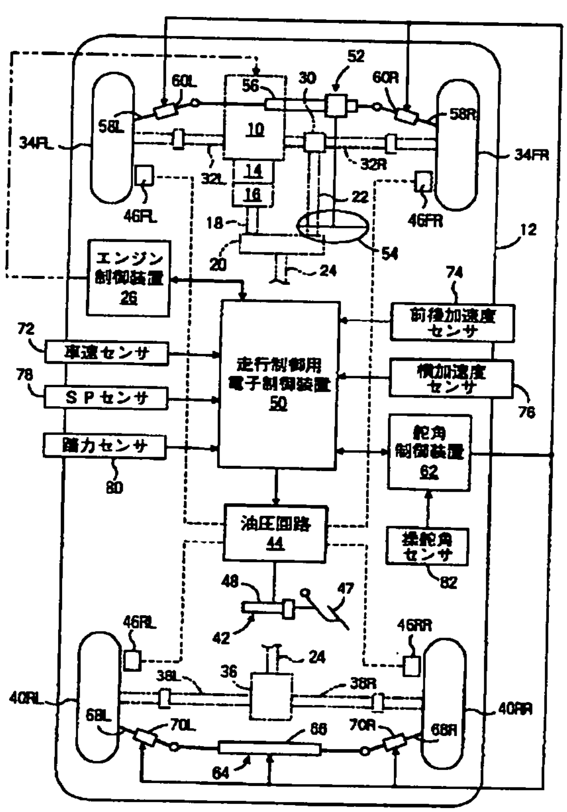
【図１０】左前輪について目標発生力F_{xytfl}が車輪座標に於ける目標車輪前後力F_{wxtfl}及び目標車輪横力F_{wytfl}に分解される要領を示す説明図である。

【図１１】右前輪及び左後輪の接地点と車輌の重心とを結ぶ線分に対し右前輪及び左後輪の目標発生力F_{xytofr}＊及びF_{xyt0rl}のベクトルがなす角度θ_{fr}及びθ_{rl}を示す説明図である。

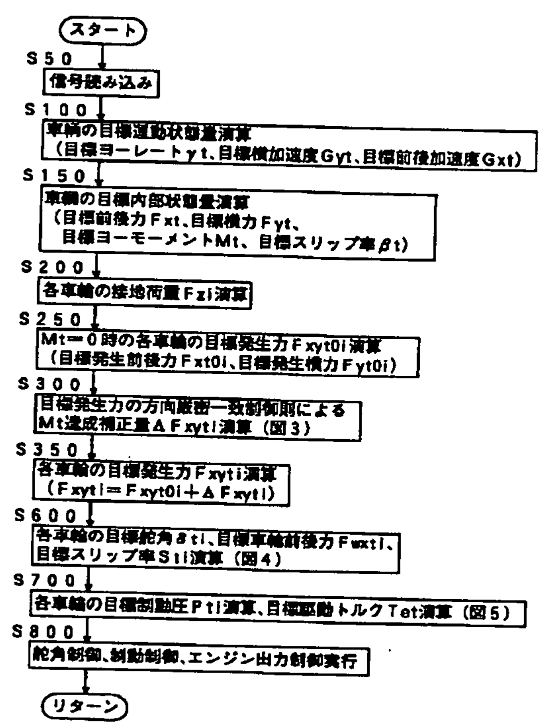
【符号の説明】

１０…エンジン
１２…車輌
１６…トランスミッション
１８…センターディファレンシャル
２６…エンジン制御装置
４２…制動装置
４４…油圧回路
５０…走行制御用電子制御装置
５２…前輪用操舵装置
６２…舵角制御装置
６４…後輪用操舵装置
７２…車速センサ
７４…前後加速度センサ
７６…横加速度センサ
７８…シフトポジションセンサ
８０…踏力センサ
８２…操舵角センサ

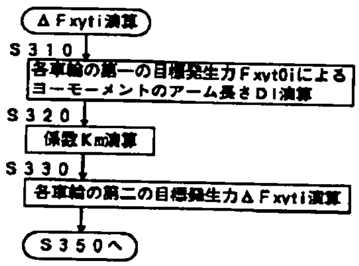
【図１】



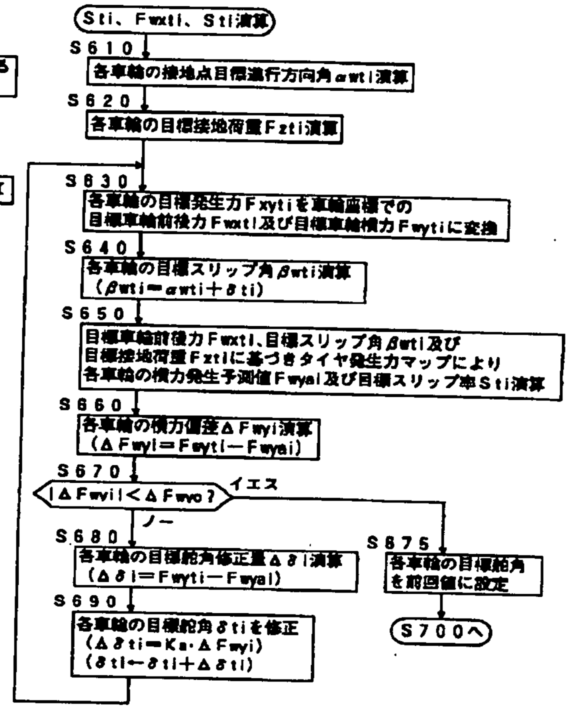
【図２】



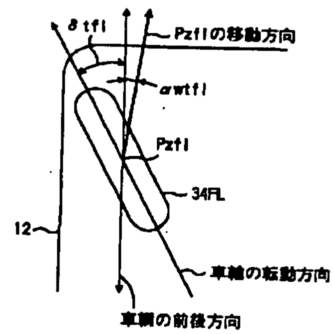
【図３】


ΔFxyti演算
S310
各車輪の第一の目標発生力Fxyt0iによるヨーモーメントのアーム長さDi演算
S320
係数Km演算
S330
各車輪の第二の目標発生力ΔFxyti演算
S350へ

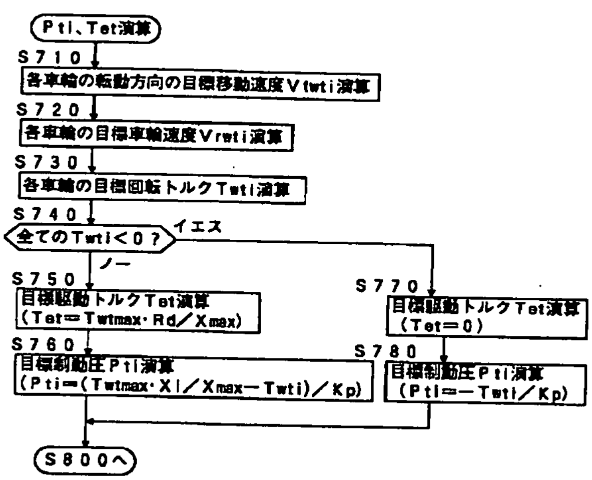
【図４】


Sti、Fwxti、Sti演算
S610
各車輪の接地点目標進行方向角αwti演算
S620
各車輪の目標接地荷重Fzti演算
S630
各車輪の目標発生力Fxytiを車輪座標での目標車輪前後力Fwxti及び目標車輪横力Fwytiに変換
S640
各車輪の目標スリップ角βwti演算
(βwti＝αwti＋δti)
S650
目標車輪前後力Fwxti、目標スリップ角βwti及び目標接地荷重Fztiに基づきタイヤ発生力マップにより各車輪の横力発生予測値Fwyai及び目標スリップ率Sti演算
S660
各車輪の横力偏差ΔFwyi演算
(ΔFwyi＝Fwyti－Fwyai)
S670
|ΔFwyi|＜ΔFwyo？
イエス
ノー
S680
各車輪の目標舵角修正量Δδi演算
(Δδi＝Fwyti－Fwyai)
S675
各車輪の目標舵角を前回値に設定
S690
各車輪の目標舵角δtiを修正
(Δδti＝Ka・ΔFwyi)
(δti←δti＋Δδti)
S700へ

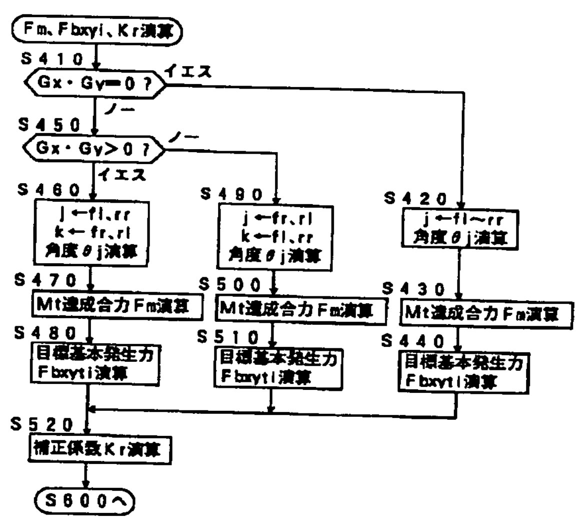
【図９】


δtfl
Pzflの移動方向
αwtfl
Pzfl
34FL
12
車輪の転動方向
車両の前後方向

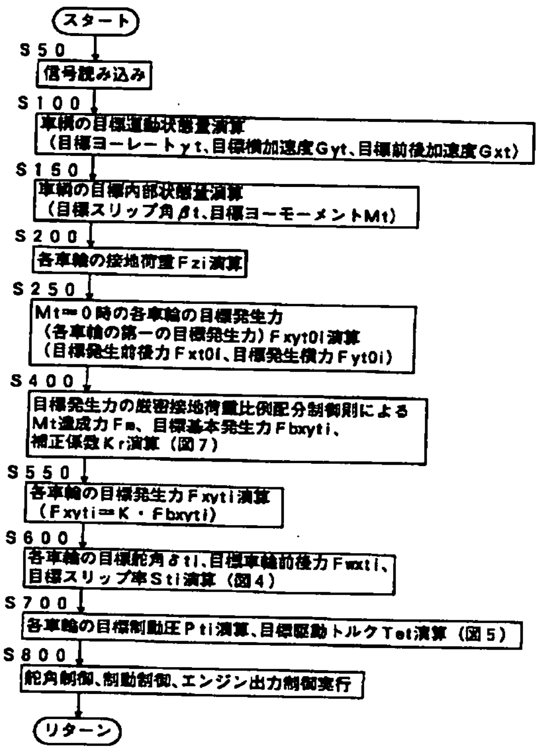
【図５】


Pti、Tet演算
S710
各車輪の転動方向の目標移動速度Vtwti演算
S720
各車輪の目標車輪速度Vrwti演算
S730
各車輪の目標回転トルクTwti演算
S740
全てのTwti＜0？
イエス
ノー
S750
目標駆動トルクTet演算
(Tet＝Twtmax・Rd／Xmax)
S770
目標駆動トルクTet演算
(Tet＝0)
S760
目標制動圧Pti演算
(Pti＝(Twtmax・Xi／Xmax－Twti)／Kp)
S780
目標制動圧Pti演算
(Pti＝－Twti／Kp)
S800へ

【図７】

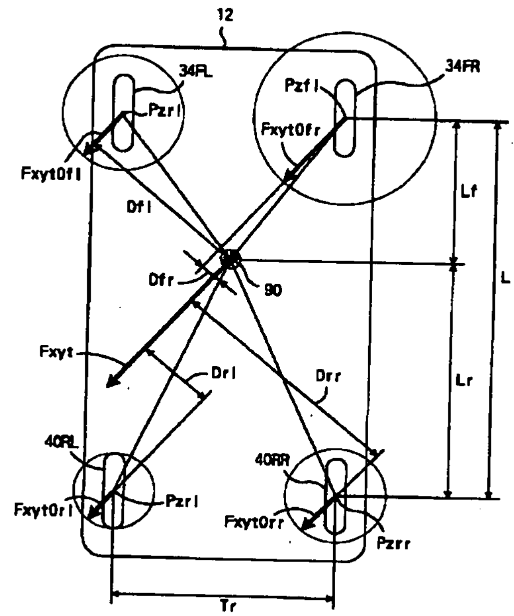

Fm、Fbxyi、Kr演算
S410
Gx・Gy＝0？
イエス
ノー
S450
Gx・Gy＞0？
ノー
イエス
S460
j←fl,rr
k←fr,rl
角度θj演算
S490
j←fr,rl
k←fl,rr
角度θj演算
S420
j←fl～rr
角度θj演算
S470
Mt達成合力Fm演算
S500
Mt達成合力Fm演算
S430
Mt達成合力Fm演算
S480
目標基本発生力Fbxyti演算
S510
目標基本発生力Fbxyti演算
S440
目標基本発生力Fbxyti演算
S520
補正係数Kr演算
S600へ

【図６】



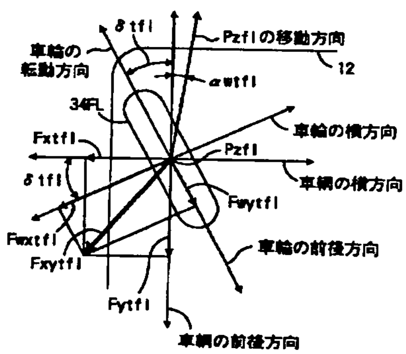
スタート
S50
信号読み込み
S100
車輌の目標運動状態量演算
（目標ヨーレートγt、目標横加速度Gyt、目標前後加速度Gxt）
S150
車輌の目標内部状態量演算
（目標スリップ角βt、目標ヨーモーメントMt）
S200
各車輪の接地荷重Fzi演算
S250
Mt＝0時の各車輪の目標発生力
（各車輪の第一の目標発生力）Fxyt0i演算
（目標発生前後力Fxt0i、目標発生横力Fyt0i）
S400
目標発生力の厳密接地荷重比例配分制御則による
Mt達成力Fm、目標基本発生力Fbxyti、
補正係数Kr演算（図７）
S550
各車輪の目標発生力Fxyti演算
（Fxyti＝K・Fbxyti）
S600
各車輪の目標舵角δti、目標車輪前後力Fwxti、
目標スリップ率Sti演算（図４）
S700
各車輪の目標制動圧Pti演算、目標駆動トルクTeti演算（図５）
S800
舵角制御、制動制御、エンジン出力制御実行
リターン

【図８】



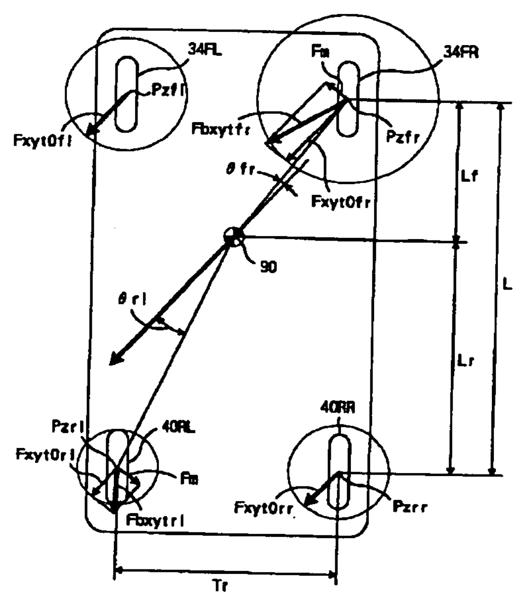
12
34FL
34FR
Pzfl
Pzrl
Fxyt0fr
Fxyt0fl
Dfl
Lf
L
Dfr
90
Fxyt
Drl
Drr
Lr
40RL
40RR
Pzrl
Fxyt0rl
Fxyt0rr
Pzrr
Tr

【図１０】



δtfl
Pzflの移動方向
車輪の転動方向
12
αwtfl
34FL
車輪の横方向
Fxtfl
Pzfl
δtfl
車輌の横方向
Fwytfl
Fwxtfl
Fxytfl
車輪の前後方向
Fytfl
車輌の前後方向

【図１１】



34FL
Fm
34FR
Pzfl
Fxyt0fl
Fbxytfr
Pzfr
θfr
Lf
Fxyt0fr
90
L
θrl
Lr
40RR
Pzrl
40RL
Fxyt0rl
Fm
Fxyt0rr
Pzrr
Fbxytrl
Tr

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103:00		103:00	
111:00		111:00	
113:00		113:00	

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